

CALFED  
BAY-DELTA  
PROGRAM

# Project Alternatives

Programmatic EIS/EIR  
Technical Appendix  
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## INTRODUCTION

The CALFED Bay-Delta Program has developed descriptions of the three comprehensive solution alternatives evaluated as part of Phase II of the Program. The alternatives represent a broad range of potential solutions to problems in the Bay-Delta system are discussed in the following sections.

Each alternative is built on a foundation of the four programs with distinguishing variations in conveyance and storage components. **The reader is referred to the appendices entitled Ecosystem Restoration Program, Water Use Efficiency Program (with water transfers), Water Quality Program, Long-Term Levee Protection Plan, Watershed Management Coordination, and Storage and Conveyance for a detailed description of the alternatives.**

The reader should keep several considerations in mind while reviewing the alternatives:

- Each alternative is structured around a set of four programs that remain relatively constant. Each program was designed with potential linkages so they each contribute in multiple ways toward achieving Program goals and a comprehensive solution to Bay-Delta problems including ecosystem quality, water quality, levee system vulnerability, and water supply reliability. The intent has been to make the total greater than the sum of its parts.
- Physical differences between the alternatives lie mainly in the method of transporting water through or around the Delta, and the amount of additional water storage included in each alternative. Each of the three alternatives includes a variety of potential combinations, or variations, of conveyance and storage consistent with the fundamental differences between the three comprehensive alternatives (Figure 1).
- While the basic composition of the programs remains relatively constant in each alternative, they may perform somewhat differently depending on the storage and conveyance components included within a specific alternative formulation. For example, the water quality program focuses each alternative on source control and reducing the level of water quality parameters of concern before they enter the Bay-Delta system. Storage proposals in various alternatives may provide additional opportunity to manage flow and diversion timing to the benefit of water quality to a greater or lesser degree than in other alternatives.
- These alternative descriptions define the range of actions that could be implemented. Beneficial and detrimental consequences will be evaluated during Phase II impact analysis.
- The final preferred alternative resulting from the Phase II process will include a set of

institutional assurances to complete the package.

- The alternatives will also include a range of reasonable operational policies and strategies. An initial description to provide context for analysis is included with each alternative.
- Some of the actions in these alternatives display ranges of values for targets or capacities; these numbers have been presented to provide a context for analysis during Phase II of the Program.
- The three alternatives were evaluated and have 12 variations.

## ALTERNATIVE 1 - EXISTING SYSTEM CONVEYANCE

This alternative essentially relies on the programs to meet Program goals, using only existing Delta channels for water conveyance, preserving the current Delta common pool as it provides a common source of water for all users dependent on delta water supplies. Three configurations (1a through 1c) with various south Delta modifications differentiate the variations in this alternative. One variation includes new surface and groundwater storage.

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Varies from existing Delta channels with no conveyance modifications to select south Delta modifications	Varies from no new storage to:  3.0 MAF Upstream (Sac) 1.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW

## ALTERNATIVE 2- MODIFIED THROUGH-DELTA CONVEYANCE

This alternative combines the programs with significant modifications of through-Delta channels to improve water conveyance across the Delta. This alternative preserves the Delta common pool in that it provides a common source of water for all users dependent on Delta water supplies. Combinations of four potential conveyance configurations and three new storage configurations differentiate the four variations (2a through 2e) of this alternative.

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Varies from channel modifications primarily for water conveyance to extensive modifications for water conveyance and habitat restoration	Varies from no new storage to:  3.0 MAF Upstream (Sac) 500 TAF Upstream (SJ) 2.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW

### ALTERNATIVE 3- DUAL DELTA CONVEYANCE

This alternative adds an isolated facility to the through-Delta modifications of Alternative 2 which together combine with the programs to move water through and around the Delta. Combinations of four potential conveyance configurations and two new storage configurations differentiate the five variations (3a through 3i) of this alternative.

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Varies from channel modifications primarily for water conveyance to extensive modifications for water conveyance and habitat restoration	Varies from no new storage to: 3.0 MAF Upstream (Sac) 500 TAF Upstream (SJ) 2.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW



Programs						Storage						Conveyance													
												South Delta				North Delta				Isolated Facilities					

## OVERVIEW OF ALTERNATIVE COMPONENTS

The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan to restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The Program addresses problems in four resource areas: ecosystem quality, water quality, levee system integrity, and water supply reliability. Programs to address problems in these four resource areas are designed and integrated to fulfill the CALFED mission.

The CALFED Bay-Delta Program has developed three alternative descriptions consisting of 12 variations for evaluation in Phase II of the Program. The alternatives represent a broad range of potential solutions to problems in the Bay-Delta system. The foundation of each alternative is a set of four common programs that remain relatively constant between alternatives.

This section focuses on the four programs. It also includes a description of the watershed management and water transfer elements in each alternative; storage and conveyance features; and the basic facility operation assumptions that remain relatively constant between alternatives. The four programs for each alternative include:

- **Ecosystem Restoration Program** - Provides for habitat improvements and reduction of stressors throughout the Bay-Delta system.
- **Water Quality Program** - Provides for improved water quality for all uses primarily by reducing pollutant load entering the Bay-Delta system and managing timing of remaining pollutants.
- **Water Use Efficiency Program** - Provides policies for implementation of cost effective measures to improve water use efficiency and water transfers.
- **Levee System Integrity Program** - Provides levee improvements throughout the Delta.

The programs each contribute in multiple ways towards achieving the mission and the CALFED Program goals. These contributions for the four Program goals are summarized in the following paragraphs:

**Ecosystem Quality** - *The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.* The ecosystem restoration program provides for significant habitat improvements for species dependent on the Delta and reduces the effects of stressors (such as unscreened diversions) that inhibit ecological processes, habitats, and species. The water quality program would reduce those water quality stressors that affect aquatic species by reducing water quality parameters of concern before they enter the waterways of the Bay-Delta system. The water use efficiency program combined with changes in facility operations may allow some shifting of water diversion timing to reduce impacts on fisheries. New levee improvements would provide some opportunities for new habitat.

**Water Quality** - *The goal for water quality in the Bay-Delta system is to provide good water quality for all beneficial uses.* The water quality program would improve water quality by reducing water quality parameters of concern before they enter the waterways of the Bay-Delta system. New aquatic habitat restoration may provide some natural bio-treatment to improve water quality. New storage and new flexibility in diversion timing would provide additional opportunities for water management and timing to improve water quality for all beneficial uses.

**Water Supply Reliability** - *The goal for water supply reliability is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.* Water supply reliability would be improved through policies for implementation of cost effective measures to improve water use efficiency, water transfers, and groundwater management. Improvements in levee system integrity should reduce the probability that water diversions would be interrupted by levee failure. Improvements in ecosystem quality should lead to healthier species populations, reduced constraints on water diversions and associated improvements in water supply reliability.

**System Vulnerability** - *The goal for addressing Bay-Delta system vulnerability is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees. Levee improvements would initially protect western Delta islands that are critical for water quality, population centers, and valuable habitats. Levee improvements would continue until an acceptable higher level of protection is provided throughout the Delta. Where possible levee rehabilitation would incorporate habitat improvements that simultaneously reduce system vulnerability, increase ecosystem quality, and improve water quality.*

The four programs for ecosystem restoration, water quality, water use efficiency, and long-term levee protection form the foundation for each alternative. Some modifications of these programs may be required depending on the specific requirements of the various storage and conveyance configurations of each alternative.

### **Ecosystem Restoration Program**

The blueprint of the CALFED Ecosystem Restoration Program is the Ecosystem Restoration Plan (ERPP). The ERPP focuses on the restoration of ecological processes associated with streamflow, stream channels, watersheds, and floodplains. These processes create and maintain habitats essential to the life history of species dependent on the Delta. In addition, the Program aims to reduce the effects of stressors, such as unscreened diversions, that inhibit ecological processes, habitats, and species.

The ecological hub of the Central Valley is the Sacramento-San Joaquin Delta and Bay. The ERPP represents a fundamental shift in the way ecological resources of the Central Valley are to be managed. For many decades, government entities, non-profit organizations, and the private sector have engaged in managing, protecting, regulating, and in some cases breeding fish and wildlife species of the Bay and Delta - yet many populations have not recovered sufficiently and remain in decline. In spite of constant human intervention to repopulate fish and wildlife that have commercial, recreational, and biological importance to society (e.g., hatchery programs and expensive re-engineered water diversions), populations have not been sustained at stable, healthy levels that support historic economic utilization of those resources.

These efforts at individual species regulation and management will be replaced by an integrated systems approach that aims to reverse the fundamental causes of decline in fish and wildlife populations. A systems approach recognizes the natural forces that created historic habitats and uses these forces to help regenerate habitats. The Bay-Delta ecosystem is not simply a list of species. Rather, it is a complex living system sustained by innumerable interactions that are physical, climatic, chemical, and biological in nature, both within and outside of the geographic boundaries of the Delta. The central theme of the ERPP is the recognition that truly durable and resilient populations of all fish and wildlife inhabiting the Bay and Delta require, above all else, the rehabilitation of ecological processes throughout the Central Valley river and estuary systems and watersheds.

The ERPP is fundamentally different from many past efforts in another way as well. It is not designed as mitigation for projects that would improve water supply reliability or to bolster the integrity of Delta levees; improvement in ecosystem functions and increases in the amount and quality of habitat are co-equal with other program goals related to water supply reliability, water quality, and system integrity.

The ERPP, like all components of the proposed Bay-Delta solution alternatives, is being developed and evaluated at a programmatic level. The complex and comprehensive nature of a Bay-Delta solution means that it would necessarily be composed of many different programs, projects, and actions that would be implemented over time. During the current phase of the Program, solution alternatives will be evaluated as a set of programs and projects so that broad benefits and impacts can be identified. In the next phase of the Program, more focused analysis and environmental documentation of specific programs and actions would occur.

The CALFED goal for ecosystem quality will be achieved by developing implementation objectives, targets and programmatic actions that can be implemented to restore ecological processes. The restoration of these processes is intended to restore and maintain habitats, and to provide for the needs of the species dependent on a healthy Bay-Delta system. For example, restoring stream channels contributes to sediments, nutrients, and a variety of habitats. The strategy recognizes that not all processes can or should be completely restored and that intervention, manipulation, and management would be required. For example, streambed gravel may have to be introduced, habitats may have to be constructed, and vegetation planted. Still, an important part of the approach is to recommend measures that in the long-term would limit the need for human intervention.

Implementation of the ERPP is further guided by the recognition that all landscape units and physical and biological components of the ecosystem are interdependent and dynamic. Interdependence means that actions and stressors in one part of the system can and do affect populations and conditions that may be separated by hundreds of miles (e.g., in watersheds and spawning tributaries), or affect the food web in ways that may not be felt for several years.

Dynamic refers to the exposure of natural systems to constant cycles of change in response to both human and natural factors. Most habitats undergo expansions and contractions, or shifts in space and time. The dynamic nature of healthy habitats is the cause of much biological diversity, and complex habitats tend to make species populations more resilient to change. If the mosaic of habitats distributed across a broad landscape is complex, and if large areas of habitat are connected by smaller patches and corridors such as those associated with riparian systems, then healthy areas of the ecosystem can be relied upon to sustain species during temporary setbacks in other areas.

## Implementation Strategy

A large and diverse ecosystem like the Bay-Delta is extremely complex. There are many processes and relationships at work in the ecosystem that are not fully understood. Thus, there are many difficulties and uncertainties associated with a program to improve ecosystem health. In some cases, problems are well understood and the steps to improvement are clear. In other cases, there is some understanding of the reasons for decline but this understanding is not sufficient to warrant full-scale implementation of remedial measures. In still other cases, additional research is needed before solutions can be identified with certainty.

The difficulties and uncertainties of ecosystem restoration call for an implementation strategy that is flexible and can accommodate and respond to new information. The foundation of the ERPP implementation strategy is **adaptive management**. Adaptive management is a process of testing alternative ways of meeting objectives, and adapting future management actions according to what is learned. Adaptive management relies upon the identification of indicators of ecosystem health, comprehensive monitoring of indicators to measure improvement over time, focused research, and phasing of actions:

**Indicators** are features or attributes of the ecosystem that are expected to change over time in response to implementation of the ERPP. Indicators are selected to provide measurable evaluations of important ecological processes, habitats, and species whose status individually and cumulatively provide an assessment of ecological health. Indicators of ecosystem health are the gauges we would use to measure progress toward the goal. Some indicators are very broad in scale while others are very specific. For example, a very broad or landscape level indicator of ecosystem health might be the total area of riparian forest or the average distance between patches of such forest. A more specific indicator might be the concentration of toxic substances in the flesh of adult striped bass.

**Comprehensive monitoring** is the process of measuring the abundance, distribution, change or status of indicators. For example, contaminant concentrations in fish tissues can be measured at various locations and times in the system to determine if contaminant levels are changing. This would allow progress to be measured, allow actions to be modified if necessary, and provide assurances that the restoration objectives are being achieved.

**Focused research** would help answer questions about the system and its components and increase the certainty surrounding the relationships of ecological processes, habitats, and species. For example, the relationships among streamflow, storm events, flow-related shaping of river channels to modify habitat, and the physical and chemical signals that flow provides for aquatic species all need to be better understood.

**Phasing** is the logical sequence of implementing restoration actions to achieve CALFED goals as effectively as possible. Phasing would consider all targets and programmatic actions and would be used to prioritize actions. For example, actions directed at recovering endangered species have a high priority. Early segments of the program would include restoration of ecological processes and habitats that are most important for endangered species recovery, reduction of stressors that affect threatened and endangered species, and other actions that may reduce conflicts between beneficial uses in the system. As restoration progresses and threats to endangered species are reduced or eliminated, restoration efforts can expand and focus on the broader issue of restoring ecological health.

### **Summary of ERPP Programmatic Actions**

Restoration of upstream habitats and establishment of extensive meander belts in the Sacramento River system would improve spawning and survival success of fish. Restoration of channel features in the lower San Joaquin River would help lower water temperatures, provide habitat, and improve survival success of fish. In the Delta, restoration of shallow riverine and riparian habitat would provide spawning areas for native fish and increase forage areas and escape cover for juvenile salmon, Delta smelt, splittail, and other species. New habitat would be constructed along Delta channels and levees. Areas of shallow tidal habitat would be developed in the Suisun Bay for wet-year spawning and rearing of Delta smelt and rearing of salmon. Fish screens would be installed on all priority diversions to reduce entrainment and keep migrating fish in the main river channel.

New water supplies would be developed in the San Joaquin basin or purchased from willing sellers and released to transport fish through the Delta and improve water quality in the San Joaquin River and south Delta. This water could be used to improve fish transport conditions in the Delta and to shift the timing of diversions to avoid entrainment effects.

In summary form, the program includes the following broad restoration ranges of programmatic actions:

- 75,000 to 120,000 acres of freshwater and brackish tidal marsh and shallow water habitat.
- 100 to 200 miles of riparian woodland and shaded riverine areas.
- 300,000 to 500,000 acre-feet annually of increased critical period flows to restore physical processes and ecological functions. The proposed flows in each ecological zone would be developed through a variety of means including reoperation of existing reservoirs, new storage (if included in the alternative), conjunctive management, and water transfers. A portion may be able to be recaptured for other uses.
- 40 to 100 tons of gravel replacement annually to enhance spawning.

- Provide new or improved fish screens at selected diversions (approximately half of existing Bay-Delta system diversions).
- Development of floodways on the San Joaquin and Cosumnes Rivers.
- Provide improved fish passage through new fish ladders or removal of barriers that limit access to habitat.
- Management of undesirable introduced species that interfere with native or economically important species.
- Management of water quality that degrades ecosystem health.

## **Water Quality Program**

The CALFED Water Quality Program goal is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses. The water quality program includes programmatic actions to reduce water quality degradation from agricultural drainage, urban and industrial runoff, acid mine drainage, wastewater and industrial discharges, and natural sources. This Program focuses on reducing the release of pollutants into the Bay-Delta system and its tributaries. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. The Program recognizes that additional benefits can be obtained by managing the timing release of remaining pollutant discharges and other dilution actions.

## **Water Quality Parameters of Concern**

Parameters of concern are constituents that cause water quality problems by affecting beneficial uses of water, or are indicators of water quality problems. The parameters of concern for the CALFED water quality program were identified with the assistance of technical experts from public agencies, private industry, and representatives of the public. Collectively, agricultural, urban, environmental, industrial and recreational interests are represented by this group. The parameters of concern to CALFED include metals and trace elements (cadmium, copper, mercury, and zinc), pesticides and other synthetic organic chemicals (carbofuran, chlordane, chlorpyrifos, diazinon, toxaphene, DDT, PCBs), minerals and nutrients (total dissolved solids, chloride, bromide, nitrates), physical characteristics (pH, temperature), toxicity and pathogens (viruses, bacteria, protozoa).

## **Water Quality Targets**

Numerical or narrative water quality targets have been developed for each parameter of concern. These targets relate to acceptable in-stream concentrations of parameters. They will be used to gauge action and alternative effectiveness at protecting beneficial uses. Targets are based on Water Quality Control Plans (Basin Plans) of the Bay Area and Central Valley Regional Water

Quality Control Boards or U.S. Environmental Protection Agency National Toxics Rule objectives, standard agricultural water quality objectives, and acceptable source drinking water quality ranges as defined by technical experts.

### **Performance Targets**

Performance targets have been established to measure the effectiveness of actions in improving water quality. Performance targets are generally stated as load reduction levels. For example, the target for copper in the Sacramento River may be to reduce copper loadings in the Upper Sacramento River from 30,000 pounds to 5,000 pounds per year. The target will be a focused outcome for actions that recommend further parameter study or research. For example, if research is required to identify sources of mercury, the outcome should be a list of the top ten most important sources along with an action program to address these sources.

### **Comprehensive Monitoring, Assessment and Research Plan**

The Water Quality Program, and all CALFED activities, must be based on the application of rigorous science. While there is some information on the existence of water quality problems in the CALFED solution area, much is yet to be learned. CALFED is developing a Comprehensive Monitoring, Assessment, and Research Plan (CMARP) to address the need for adequate scientific support not only in the water quality area, but also for the system integrity, ecosystem restoration, and water supply reliability resource areas. The CMARP is central to the CALFED philosophy of adaptive management. The water quality component of the CMARP will provide for:

### **Sources of Water Quality Problems**

Sources of water quality problems in the Delta and its tributaries include:

- Acidic drainage from inactive and abandoned mines that introduces metals such as zinc, cadmium, copper, and/or mercury;
- stormwater inflows and urban runoff that may contribute selenium, turbidity, pathogens, organic carbon, nutrients, pesticides, and/or other chemical residues;
- municipal and industrial discharges that may contribute salts, trace elements, nutrients, metals, pathogens, chemical residues, oil and grease, and/or turbidity;
- agricultural tail water, or return flows, that may contribute salts, nutrients, pesticide residues, pathogens, and/or turbidity; and,
- subsurface agricultural drainage that may contribute salts, nutrients, pesticides (some fungicides), selenium, and/or other trace elements.



## Action Strategies to Address Water Quality Problems

Action strategies have been developed under the Water Quality Program to address water quality problems in the Delta and its tributaries. The strategies are recommended actions to reduce loadings from the sources of water quality problems (e.g., mine drainage, agricultural drainage, urban and industrial runoff, and municipal and industrial wastewater treatment facilities), to improve source water quality; to upgrade water treatment plants, or to change water management practices.

Action strategies to address water quality problems include a combination of research, pilot studies and full-scale actions. For some parameters, such as mercury, there is little understood about its sources, the bioavailability of the various sources, and the load reductions needed to reduce fish tissue levels. For this parameter further study is recommended before full-scale actions are taken. For other parameters, such as selenium, sources are better documented, and source control or treatment actions can be taken with a reasonable expectation of positive environmental results. The actions that follow highlight some of the major strategies that make up the Water Quality Program. A complete listing of actions can be found in the CALFED Water Quality Report.

### Delta

*Action strategies to address water quality problems in the Delta address urban and industrial runoff, municipal and industrial wastewater, agricultural drainage, and source control and treatment. Following is a description of the main action strategies for each of these sources.*

Mine drainage actions will reduce mercury loadings to the Delta from abandoned and inactive mines. These actions include source control and treatment measures. Actions for mercury occur throughout the basin and are primarily being addressed through a system-wide research-program that will attempt to identify bioavailable forms of mercury, sources of the bioavailable forms and an action plan to reduce the loadings of these forms. Pilot scale actions are recommended for mines that drain mercury to Cache Creek and the Yolo Bypass.

Urban and industrial runoff actions will help to reduce toxicity from the pesticides chlorpyrifos and diazinon, copper, and oxygen depletion in the Delta, and to reduce pathogens. Actions include both source control and treatment measures.

Municipal and industrial discharge actions will help to reduce pathogens and oxygen depletion. These actions include source control and treatment measures including improved management of boat discharges and additional source control or treatment at wastewater treatment plants.

Agricultural drainage actions will reduce toxicity from the pesticide carbofuran, chlorpyrifos, and diazinon in the Delta. Actions are primarily source control measures such as best management practices (BMPs).

Actions to improve the quality of drinking water sources include relocation of water supply intakes to avoid areas of high salinity, total organic carbon, and turbidity.

Actions to improve drinking water quality include upgrades to treatment processes to improve disinfection while reducing production of unwanted disinfection byproducts.

Actions to address unknown toxicity focus on development of a comprehensive monitoring, assessment, and research program to identify toxicities, the sources of these toxicities, and action plans to address unknown toxicity in the Delta and its tributaries.

### **Sacramento Basin**

*Action strategies in the Sacramento Basin predominantly include mine drainage actions with some agricultural drainage and urban and industrial runoff actions. Following is a description of the main action strategies for each of these sources.*

Mine drainage actions will reduce mercury, cadmium, copper, and zinc loadings to the Sacramento River and its tributaries from abandoned and inactive mines. These actions include point source and non-point source measures. Actions for cadmium, copper, and zinc are focused at mine sites that drain into the upper Sacramento River. Actions for mercury occur throughout the basin and are primarily being addressed through a system-wide research-program to identify bioavailable forms of mercury, sources of the bioavailable forms and an action plan to reduce the loadings of these forms.

Urban and industrial runoff actions will reduce toxicity of the pesticide chlorpyrifos and diazinon in the Sacramento River and its tributaries from urban areas. These actions will include implementation of pesticide usage BMPs in urban areas.

Agricultural drainage actions will reduce toxicity from the pesticides carbofuran, chlorpyrifos, and diazinon in the Sacramento River and its tributaries from agricultural areas. Actions are primarily source control measures such as BMPs, especially from farm areas that drain to the Feather River, Colusa Basin Drain, and mainstem Sacramento River.

Actions to address unknown toxicity focus on development of a comprehensive monitoring, assessment and research program to identify toxicities, the sources of these toxicities, and action plans to address unknown toxicity in the Sacramento River and its tributaries.

## San Joaquin Basin

*Action strategies in the San Joaquin Basin predominantly include agricultural drainage actions with limited mine drainage actions. Following is a description of the main action strategies for each of these sources.*

Subsurface agricultural drainage discharged to the San Joaquin River from the grasslands area are perhaps the most significant cause of water quality problems, specifically selenium and salinity (total dissolved solids, chloride, bromide), in the River. CALFED agricultural drainage actions include drainage reduction and reuse, timed drainage release, drainage treatment to reduce trace elements and other contaminants, salt separation and utilization and land use changes to reduce drainage quantities. Agricultural drainage actions will reduce toxicity from the pesticides chlorpyrifos and diazinon in the San Joaquin River and its tributaries from agricultural areas. Actions are primarily source control measures such as BMPs, particularly in farm areas that drain to Mud and Salt sloughs, and the San Joaquin River.

Actions to address mine drainage associated with loadings of cadmium and zinc to the San Joaquin Basin (specifically the Mokelumne River) have been undertaken as part of the Penn Mine Remediation Plan. However, mercury loadings continue to be a problem in the basin. Actions for mercury occur throughout the basin and are primarily being addressed through a system-wide research program that will attempt to identify bioavailable forms of mercury, sources of the bioavailable forms and an action plan to reduce the loadings of these forms.

Actions to address unknown toxicity focus on development of a comprehensive monitoring, assessment and research program to identify toxicities, the sources of these toxicities, and action plans to address unknown toxicity in the San Joaquin River and its tributaries.

- Establishing a quality assurance/quality control program to assure the scientific validity of CALFED data collection;
- Establishing the actual existence and severity of water quality problems, including evaluating the ecosystem effects of water quality parameters;
- Establishing baseline water quality conditions against which CALFED actions will be measured; and,
- Evaluating the effectiveness of CALFED water quality improvement actions and identifying the need for adaptive management actions.

## Water Use Efficiency Program

The Water Use Efficiency Program reflects California's well accepted public policy, that places a strong emphasis on efficient use of developed water supplies. At CALFED scoping sessions, participants expressed a strong sentiment that water use efficiency should figure prominently in

all the CALFED alternatives, and that existing supplies must be used efficiently before undertaking costly efforts to develop additional supplies or improve the ability to convey water across the Delta.

Many local water agencies in California have strong water use efficiency programs. The greatest current challenge in water use efficiency is finding ways to encourage more water users and water suppliers to implement proven cost-effective efficiency measures that are being used successfully by their peers throughout the state.

The term efficiency may be defined in different ways. Increases in physical efficiency and increases in the achievement of CALFED objectives through improved water management would be direct results of the water use efficiency program. Increasing economic efficiency -- which might result in a reallocation of water -- is not a specific objective of the Program but would likely be an indirect result.

The CALFED water use efficiency program differs from other components of proposed Bay-Delta solution alternatives in two fundamental ways: it is concerned with policy, not technical issues, and **most actions would be implemented by local agencies rather than CALFED agencies.**

Implementation objectives were established in order to guide the development of approaches for water use efficiency. These objectives are intended to reflect and protect the various stakeholder interests regarding local water use management and efficiency. The objectives were used during program development to test whether a draft approach was satisfactory. There are general objectives as well as specific objectives for urban water conservation and agricultural water use efficiency. General objectives include:

- Ensure a strong water use efficiency component in the Bay-Delta solution.
- Emphasize incentive based actions over regulatory actions.
- Preserve local flexibility.
- Remove disincentives and barriers to efficient water use.
- Offer greater help in the planning and financing of local water use management and efficiency improvements.

Objectives that relate to urban water use efficiency improvements include:

- Incorporate the strengths and benefits of the California Urban Water Conservation Council and the Memorandum of Understanding Regarding Urban Water Conservation in California.
- Provide assurance that a high "floor" level of conservation implementation would occur.

Objectives that relate solely to agricultural local water use management and efficiency improvements include:

- Build on the progress and achievements of the *Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California* (AB 3616).
- Provide adequate assurance that agricultural water supplies would be used at highly efficient levels.
- Improve local water use management to achieve multiple benefits.

The CALFED solution alternatives must provide assurance that appropriate water management planning is carried out by local agencies and that cost-effective efficiency measures are implemented. Demonstration of appropriate planning and implementation would be necessary prerequisites for an agency to be eligible to:

- Receive any "new" water made available by a Bay-Delta solution,
- Participate in a water transfer that requires approval by any CALFED agency or use of facilities operated by any CALFED agency, and
- Receive water through the DWR Drought Water Bank. (This is already a policy of DWR.)

The Water Use Efficiency Program includes policies covering five main areas.

- **Agricultural Water Use Efficiency** - The agricultural approach recognizes a clear standard for voluntary agricultural water management planning and a balanced process for recognition of adequate programs of planning and implementation. The approach is supported by planning and technical assistance, financing assistance, and proposed assurances.
- **Urban Water Conservation** - The urban approach recognizes a clear standard for implementation of cost-effective conservation measures and responsibility to carry out local water management planning. The approach establishes a process for recognition of adequate planning efforts and recommends a balanced process for recognition of adequate conservation implementation. The approach is supported by planning and technical assistance, financing assistance, and proposed assurances.
- **Efficient Use of Environmental Diversions** - In addition to the broad categories of urban and agricultural water needs, there are important water use efficiency issues related to use of environmental water supplies. Policies related to efficient use of environmental diversions are being examined in the context of the water use efficiency program. Three CALFED agencies are working with other

organizations to develop an Interagency Coordinated Program for optimum water use planning for wetlands of the Central Valley. This program would identify BMPs for refuge water management and would develop a water use management planning process for refuge and wetland areas of the Valley. The Interagency Coordinated Program would work closely with, and coordinate with, CALFED to assure consistency of policy, meet the general implementation objectives for water use efficiency, and propose mechanisms that assure the efficient use of water on refuges, wildlife areas, and managed wetlands..

- **Water Recycling** - The recycling approach establishes a process for recognition of water recycling planning. The approach could include water recycling planning and implementation, technical and planning assistance, funding assistance, and identification of regional water recycling opportunities. This approach will be developed in coordination with appropriate CALFED agencies and consultation with stakeholders and the public, including the Water Use Efficiency Work Group.
- **Water Transfers** - This approach (which is in progress) will be developed in coordination with appropriate CALFED agencies and consultation with stakeholders and the public, including the Water Use Efficiency Work Group.

One of the main objectives of the Water Use Efficiency Program is to maintain local flexibility in the implementation of cost-effective efficiency actions. For this reason, each of the approaches include only policy level actions and do not attempt to identify technical actions. The intention of the program is to provide the nexus for local water suppliers and water users to implement the appropriate technical actions.

Local water suppliers and water users have a large array of technical actions to evaluate and implement. These actions are included in the approach by reference to the following:

- The *Memorandum of Understanding Regarding Water Conservation in California* which lists 16 BMPs to be analyzed and, if cost-effective, implemented by local agencies.
- The *Urban Water Management Planning Act* (California Water Code 10610 et. seq.)
- The *Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers in California* which includes several Efficient Water Management Practices (EWMPs) to be analyzed and, if cost-effective, implemented by local agencies.

In addition, technical and planning assistance programs would provide access to numerous other technical actions, especially for consideration at the on-farm level. CALFED Program support would also foster collaboration between water suppliers to analyze technical actions from a basin-wide perspective.

Though unknown as to the actual outcome of local water use management and efficiency improvements, it is assumed that the component would result in significant changes from existing conditions. The extent to which such changes occur independent of the CALFED Program, is not known either, for efficiency improvements would continue to occur regardless of the Program. However, the Program would facilitate greater levels of implementation than would otherwise be expected to occur. The following is anticipated as a result of both current trends and the added influence of the CALFED Program:

- Implementation of urban BMPs could result in a 10 to 20% reduction in total municipal and industrial demand. Water saved would most likely be used to improve the reliability of existing water supplies and to offset future demands.
- Implementation of agricultural EWMPs could result in real water savings from the reduction of losses. This could be 1 to 3% of the total demand. This water would be available for reallocation to other beneficial uses, whether in the same district or another, for other agricultural users, for urban demand, or to meet environmental needs. Reallocation of saved water would most likely occur through water transfer markets.
- Implementation of agricultural EWMPs could also result in 8 to 12% reductions in current applied water demands. These reductions do not, however, necessarily constitute a source of water that can be reallocated to other beneficial uses. Instead, applied water reductions can provide water quality benefits, allow changes in the timing of reservoir releases, and reduce entrainment impacts associated with diversions.
- Increased implementation of urban recycling projects, both local and regional, could provide 1 to 2 million acre-feet of reusable supply. For local projects, water recycled would most likely be used to improve supply reliability or offset future demands. Regional projects may allow the reallocation of reusable water to other beneficial uses, including agriculture and the environment. These reallocations may or may not make use of water transfer markets.
- Changes in water use management at wetlands areas and refuges would not generate water to be reallocated to other uses. Rather, management changes could provide opportunities to modify the timing of wetland dewatering to correspond to water quality needs, or changes could result in reductions in applied water, with benefits similar to that of agriculture.

### **Levee System Integrity Program**

Improvements to Delta levees and channels are included in the Long-Term Levee Protection Plan prepared under the Levee System Integrity Program to reduce the risk of failure due to floods, earthquake, and general deterioration of the facilities. The Program will provide for uniform funding and guidance to increase the level of protection throughout the Delta.

Levee improvements would initially protect western Delta islands that are critical for water quality, population centers, and valuable habitats. Levee Improvements would continue until an acceptable higher level of protection is provided throughout the Delta. However, ongoing activities such as emergency repairs, the feasibility of beneficial reuse of dredge materials and the Delta configuration may change what is ultimately achievable.

The Program focuses on approaches to improve the integrity of the levee system:

- **The Delta Levee Base Level Protection Plan** strives to use existing programs to increase the extent of Delta project and nonproject levees that meet minimum federal flood control performance criteria. Local reclamation districts would provide the primary source of resources for maintaining and improving the Delta levee system, with increased State and federal participation and resources.
- **The Delta Levee Special Improvement Projects** provide increased flood protection beyond the Delta Levee Base Level Protection Plan for Delta islands with many public benefits.
- **The Delta Island Subsidence Control Plan** promotes island subsidence to provide long-term reliability of Delta levees in coordination with other agencies and stakeholders.
- **The Delta Levee Emergency Management Plan** will build upon existing emergency management resources to protect critical Delta resources during an emergency.
- **The Delta Levee Seismic Risk Assessment** will identify and increase the understanding of the seismic risks to Delta resources and develop recommendation for increasing Delta levee seismic stability.



## Watershed Management Coordination

The CALFED Bay-Delta Program is developing and implementing a comprehensive plan to address a declining ecosystem, uncertain water supplies, and imperiled water quality. This plan will include an integrated approach to solving these problems and watershed management is one of the components of that approach. Watershed management will be included in each of the three alternative Bay-Delta solutions as a means of improving water quality, including enhancing sources of drinking water, overall ecosystem and increased water yield.

As defined in this policy, watershed management is a comprehensive, integrated, basin-wide approach that takes into account many water quality problems including but not limited to point and non-point pollution sources, habitat loss, surface and groundwater degradation.

The Program fosters local stewardship and supports community-based watershed interests. The Program might, for example, work with local agencies to assist in the formation of alliances or cooperative projects to improve water quality for beneficial uses on a larger scale that might be possible with local agencies working alone or in more narrowly scoped programs.

The Program supports sound scientific investigations and pilot programs to develop and demonstrate methods for protecting and enhancing beneficial uses of the Bay-Delta system. An important component of the Programs support for programs is to assure development of adequate technical documentation to support decision-making in a long-term adaptive management process. For example, the Program might assume a leadership role by providing educational opportunities and coordinating assessment activities throughout the watershed's tributary to the Bay-Delta to assure uniform data collection protocols, uniform application of quality control, standardized analyses, and compatible database structures.

Emphasis for the Program involvement in watershed management activities will be placed on activities that are consistent with its solution principles to reduce conflict, and to be equitable, affordable, durable, implementable and not to have significant redirected impacts. Other criteria such as technical, economical, financial and institutional feasibility will also be considered for any watershed management project.

The problems to be addressed by the Program are those in the legally defined Delta (generally extending north to Sacramento, east to Interstate 5, south to Tracy and west to Chipps Island), Suisun Bay (extending to the Carquinez Strait), and Suisun Marsh. To address problems in the Delta estuary, Program activities may extend throughout the Central Valley watershed, the Southern California water system service area and the portion of the Pacific Ocean out to the Farallon Islands.

In all such activities, it will be the Program role to assist implementation of projects on a larger watershed scale to help unify and provide a cost-effective approach to individual watershed management activities. Ways that the Program might accomplish this include:

- Taking an active role to help plan and coordinate outreach and education programs. The Program will serve as a clearinghouse for information related to watershed-wide activities affecting the Bay-Delta system. The Program will develop a Model Work Plan and funding information for use by local watershed groups.
- Supporting and fostering local watershed management activities through technical, financial and policy activities.
- Soliciting assistance in developing selection criteria for Program-funded watershed implementation projects.
- Soliciting technical information and will involve the stakeholders and agencies developing a standardized approach to assure uniform data collection protocols, application of quality control, standardized analyses, and compatible database structures.
- Conducting a survey to assess the number of stakeholder groups who have a vested interest in the benefits of a watershed program. Watershed stakeholders will be actively solicited for their cooperation and the Program will serve as a central network for information among these stakeholders to help ensure coordination.
- Developing a Watershed Strategic Plan containing a stakeholder agreed-upon vision for the future of the watersheds affecting the Bay-Delta system. This plan will establish water quality, ecosystem restoration, and resource goals.
- Helping to provide quality control checks to existing and new watershed monitoring programs to enable accurate measurements and decision-making.
- Integrating existing watershed management programs and agency mandates with additional actions supporting the Programs Solution Principles.
- The Programs watershed management activities will be fully coordinated with existing or new watershed management programs affecting the Bay-Delta system including, but not limited to, the State Water Resources Control Board's Sacramento River Watershed Program, the Sacramento River Toxic Pollutant Control Program, and the federal, State and Regional Water Quality Control Board's Watershed Management Initiative Program.

## Water Transfers

Water Transfers are an important part of the CALFED Program's effort to improve water supply reliability. The water transfer element does not propose a water transfer market that is actively managed by the Program. Rather, the Program recognizes that transfers are part of the overall water management landscape in California. The element proposes that the CALFED agencies work cooperatively to facilitate a statewide water transfer market consistent with the Governor's water policy on transfers and the CALFED solution principles.

The water transfer element will encourage the development of an effective, standardized water transfer market. The Program will seek to encourage the development of a uniform set of rules and criteria to be consistently applied to transfers by affected State and federal agencies.

## Storage and Water Conveyance

### Storage

New storage would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

The first priority for development of surface storage will be to raise existing dams. The second priority will be to develop off-stream storage. The last priority will consider development of new on-stream storage. Groundwater storage development will be implemented with demonstration projects in partnership with local agencies with attention to groundwater levels, water quality, local economic impacts, and any other third party impacts.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries
- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 200 TAF in-Delta storage
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

## Water Conveyance

Conveyance components would serve to convey water from north of the Delta to south of the Delta. The various conveyance components in this category range from modifications to current facilities in the south Delta to improvements to existing Delta channels to the construction of an isolated transfer facility.

Several features proposed to improve current facilities include:

- South Delta Modifications are intended to result in removal of current regulatory constraints and thus allow the export pumps to operate at their physical capacity.
- CVP-SWP improvements to provide additional operational flexibility.

Through-Delta improvements include:

- Physical modification of Delta channels to support continued conveyance through the Delta from north to south. The through-Delta conveyance capacity could range from use of the existing unaltered channels to channel enlargements by dredging and setback levees. Improvements to north Delta channels could be designed to provide multiple benefits for flood conveyance, habitat restoration, water supply, and south Delta water quality.
- A new screen or unscreened diversion (up to 10,000 cfs) from the Sacramento River along with channel modifications will increase flow capacity and decrease flow velocity.
- The channel improvements include corridors of habitat along selected channels; setback levees to provide restored shaded riverine aquatic habitat, shallow water habitat, as well as increased water conveyance and flood protection; and conversion of islands into tidally influenced habitat.

Dual Delta Conveyance is formed around a combination of improved through Delta conveyance and new isolated conveyance. It includes:

- A new screened diversion facility on the Sacramento River between Hood and Freeport could supply a new isolated conveyance facility to transport water around the east side of the Delta to the existing south Delta pumping plants. The new screened diversion facility may also supply water for continued through-Delta conveyance.
- The isolated conveyance can be sized and operated to convey from 5,000 to 15,000 cfs to the south Delta export facilities. For some of the smaller isolated conveyance capacities, a buried pipeline concept will be evaluated. Other

- configurations could include alternate conveyance routings such as the isolated conveyance constructed as a series of flooded islands connected by siphons. The through-Delta conveyance capacity could range from use of the existing unaltered channels to channel enlargements by dredging and setback levees. Improvements to north Delta channels could be designed to provide multiple benefits for flood conveyance, habitat restoration, water supply, and south Delta water quality.

## **FACILITY OPERATIONS**

The four programs form the foundation for each CALFED alternative. When supplemented by various storage and conveyance configurations with their corresponding facility operation assumptions, these programs perform in different ways to achieve Program goal objectives.

Each alternative has a set of assumptions for use in modeling facility operations that varies depending on the storage and conveyance configurations. These operating assumptions are based on the operating assumptions for the No-Action Alternative. The descriptions of each CALFED alternative illustrates how the operational assumptions differ from those for the No-Action Alternative.

### **Operation Assumptions for No-Action Alternative**

The DWR Planning Simulation Model (DWRSIM) study 472 presents the operation assumptions for the No-Action Alternative. Study 472 meets the State Water Resources Control Board's (SWRCB) May 1995 Water Quality Control Plan and includes selected upstream Endangered Species Act requirements and Central Valley Project Improvement Act (CVPIA) flow prescriptions.

### **Operation Assumptions for Existing Conditions**

Each CALFED alternative will be compared, during impact analysis with the existing conditions and the No-Action Alternative. The DWRSIM study 469 presents the operation assumptions for existing conditions. Study 469 meets D-1485, selected upstream requirements and CVPIA flow criteria, SWRCB's May 1995 Water Quality Control Plan, and additional water is provided from the San Joaquin River upstream of its confluence with the Stanislaus, if necessary, to meet salinity and pulse flow objectives at Vernalis.

## ALTERNATIVE 1 - EXISTING SYSTEM CONVEYANCE

This alternative essentially relies on the programs to meet Program Goals, using only existing Delta channels for water conveyance, preserving the Delta common pool as currently in place in that it provides a common source of water for all users. Three configurations with various south Delta modifications differentiate the variations in this alternative. One variation includes new surface and groundwater storage.

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Varies from existing Delta channels with no conveyance modifications to select south Delta modifications	Varies from no new storage to:  3.0 MAF Upstream (Sac) 1.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW

## OVERVIEW

This alternative relies on the four programs of ecosystem restoration, water quality, water use efficiency, and long-term levee protection together with existing Delta channel conveyance to improve each of the target resource areas and to achieve Program goals and objectives. This alternative preserves the Delta common pool in that it provides a common source of fresh water for all users. Three configurations within this alternative include some modifications within the south Delta and a range of potential surface and groundwater storage.

The programs contribute in multiple complementary aspects toward achieving the CALFED mission and Program goals as partially illustrated in the following descriptions of programs in the introduction to this appendix:

**Ecosystem Quality** - *The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.*

**Water Quality** - *The goal for water quality in the Bay-Delta system is to provide good water quality for all beneficial uses.*

**Water Supply Reliability** - *The goal for water supply reliability is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.*

**System Vulnerability** - *The goal for addressing Bay-Delta system vulnerability is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.*

## **ALTERNATIVE DESCRIPTION VARIATIONS WITHIN ALTERNATIVE 1**

As with all alternatives, the four programs form the foundation for Alternative 1. Watershed management and water transfer elements are the same for each alternative and are not discussed further in this section. Three storage and conveyance configurations are being analyzed as possible Alternative 1 options.

### **Alternative 1A**

Alternative 1A combines and integrates the four programs without adding new storage and conveyance facilities to supplement the status quo. Figure 1A shows the Alternative 1A configuration. The main elements of the programs are summarized below. The reader is referred to the Summary of Programs at the beginning of this appendix for a more detailed description of all programs.

#### **Ecosystem Restoration Program**

The Ecosystem Restoration Program (ERP) describes proposed ecosystem improvements throughout the Bay-Delta System, including:

- Habitat restoration of approximately 150,000 acres
- Changes in environmental water flows through operational adjustments
- Development of floodways and meander zones
- Fish passage improvements
- Fish screens installations
- Management of undesirable species
- Water quality improvements through implementation of the Water Quality Program

Alternative 1A would implement the entire ERP with the following modifications:

- Operational changes in environmental water flows would be achieved through purchase of water from willing sellers rather than reliance on regulatory mandates.
- Habitat restoration identified for the South Delta area would be relocated to the northern and western Delta. This change would provide for intensive habitat restoration to be located prudently distant from the South Delta pumping facilities.



## **Water Quality Program**

The CALFED Water Quality Program goal is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses. The water quality program includes programmatic actions to reduce water quality degradation from agricultural drainage, urban and industrial runoff, acid mine drainage, wastewater and industrial discharges, and natural sources. This Program focuses on reducing the release of pollutants into the Bay-Delta system and its tributaries. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. The Water Quality Program recognizes that additional benefits can be obtained by managing the timing release of remaining pollutant discharges and other dilution actions.

The entire Water Quality Program would be implemented for Alternative 1A with the following addition:

- Evaluate relocating water supply intakes (such as North Bay Aqueduct, Tracy, and Contra Costa Water District intakes) to avoid salts and organic carbon that reduce the ability to recycle water and that complicate disinfection and are sources of disinfection byproducts.

## **Water Use Efficiency Program**

The Water Use Efficiency Program is California's well accepted public policy that places a strong emphasis on efficient use of developed water supplies. The CALFED water use efficiency program differs from other components of a Bay-Delta solution in two fundamental ways: it is more concerned with policy, not technical issues, and most actions would be implemented by local agencies rather than CALFED agencies.

No changes in the Water Use Efficiency Program are needed to implement Alternative 1A.

## **Levee System Integrity Program**

The Levee System Integrity Program focuses on five approaches to improve the long-term structural integrity of the levee system in the Delta and in specific locations upstream:

- **The Delta Levee Base Level Protection Plan** strives to use existing programs to increase the extent of Delta project and nonproject levees that meet minimum federal flood control performance criteria. Local reclamation districts would

- provide the primary source of resources for maintaining and improving the Delta levee system, with increased State and federal participation and resources.
- **The Delta Levee Special Improvement Projects** provide increased flood protection beyond the Delta Levee Base Level Protection Plan for Delta islands with many public benefits.
- **The Delta Island Subsidence Control Plan** promotes island subsidence to provide long-term reliability of Delta levees in coordination with other agencies and stakeholders
- **The Delta Levee Emergency Management Plan** will build upon existing emergency management resources to protect critical Delta resources during an emergency.
- **The Delta Levee Seismic Risk Assessment** will identify and increase the understanding of the seismic risks to Delta resources and develop recommendation for increasing Delta levee seismic stability.

No changes in the Levee System Integrity Program are needed for Alternative 1A.

### **Conveyance**

No conveyance improvements are included in Alternative 1A.

### **Storage**

No new water storage is included in Alternative 1A.

### **Operations**

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. No changes in these assumptions are proposed for implementation of Alternative 1A. However, some reoperation of system facilities will occur to accommodate changes in flow timing resulting from potential purchases of supplemental environmental flows from willing sellers.

## **Alternative 1B**

Alternative 1B combines and integrates the four programs with select south Delta improvements. Alternative 1B builds upon Alternative 1A by adding fish screens at the Banks and Tracy pumping plants and an intertie between the Tracy pumping plant and Clifton Court Forebay. All programs fit together as they did in Alternative 1A. Figure 1B shows the Alternative 1B configuration.

### **Ecosystem Restoration Program**

Same as Alternative 1A

### **Water Quality Program**

Same as Alternative 1A.

### **Water Use Efficiency Program**

Same as Alternative 1A.

### **Levee System Integrity Program**

Same as Alternative 1A.

### **Conveyance**

Proposed **South Delta Modifications** are intended to result in removal of current regulatory constraints and thus allow the export pumps to operate to their physical capacity. These improvements include:

- Installation of an operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River.
- Flow and stage control measures on Middle River, Grant Line Canal, and Old River or other methods to control flow, stage, and south Delta salinity

**CVP-SWP improvements** to provide additional operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility
- New fish screens at the Tracy Pumping Plant intake
- Intertie between Tracy Pumping Plant and Clifton Court Forebay to provide operational flexibility to minimize fisheries impacts

### **Storage**

As in Alternative 1A, no new water storage is proposed in Alternative 1B.

### **Operation Assumptions**

Same as Alternative 1A except for the operational flexibility to shift diversions from Tracy to Banks Pumping Plant and visa versa to promote fisheries and water quality.

### **Alternative 1C**

Alternative 1C builds on Alternative 1B by adding new conveyance to provide for increasing in the permitted south Delta pumping capacity to the full physical capacity. Alternative 1C is the same as Alternative 1B except that it includes new surface and groundwater storage facilities throughout the watershed. Figure 1C shows the Alternative 1C configuration.

### **Ecosystem Restoration Program**

Alternative 1C would implement the entire ERPP with the following change from Alternatives 1A and 1B:

- Some environmental water flows would be met through use of new storage specifically allocated to environmental water supplies.

### **Water Quality Program**

Same as Alternatives 1A and 1B.

### **Water Use Efficiency Program**

Same as Alternatives 1A and 1B.

### **Levee System Integrity Program**

Same as Alternatives 1A and 1B.

### **Conveyance**

Proposed **South Delta Modifications** are intended to result in removal of current regulatory constraints and thus allow the export pumps to operate to their physical capacity. These improvements include:

- A new Clifton Court Forebay intake structure
- Channel enlargement along a 4.9 mile reach in Old River

- Installation of an operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River.
- Flow and stage control measures on Middle River, Grant Line Canal, and Old River or other methods to control flow, stage, and south Delta salinity

**CVP-SWP improvements** to provide additional operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility
- New fish screens at the Tracy Pumping Plant intake
- Intertie between Tracy Pumping Plant and Clifton Court Forebay to provide operational flexibility to minimize fisheries impacts

### **Storage**

**New storage** would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 1.0 MAF surface storage off-aqueduct (South of Delta)
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

### **Operations**

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. These are supplemented by the following specific operational assumptions for Alternative 1C:

#### **Surface and Groundwater Storage Components**

- All new surface storage facilities will be operated primarily to maximize average annual deliveries to meet all beneficial uses.
- All new groundwater and conjunctive use facilities will be operated primarily to maximize average dry year delivery to all beneficial uses.

- Filling of and discharging from new storage will be made with the following priorities (*The following will be consistent with local water management practices and water rights*):
  - Tributary groundwater storage facilities have first priority for filling and last priority for discharging from storage (withdrawals from groundwater basins will only be made in dry and critical years).
  - Aqueduct groundwater storage facilities have second priority for filling and fourth priority for discharging from storage.
  - Aqueduct surface storage facilities have third priority for filling and third priority for discharging from storage.
  - Tributary surface storage facilities have fourth priority for filling and second priority for discharging from storage.
  - Delta storage facilities have fifth priority for filling and first priority for discharging from storage.
- All new storage is assumed to be split evenly among the “three beneficial use sectors”, such that we have one-third for environmental purposes, one-third for urban purposes, and one-third for agricultural purposes.
- For 500 TAF of groundwater storage, diversion capacity is 500 cfs. Discharge capacity is 500 cfs. Flow event targets as specified for surface storage are not applicable for diversions to groundwater storage.

#### **Tributary Storage (Sacramento River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off stream storage is 5,000 cfs.
- For new diversion points between Keswick and Chico Landing, no new diversions allowed in any given water year until a 60,000 cfs mean daily flow event that preserves the river’s natural fluvial geomorphology process has occurred at Chico Landing. (Future study will be conducted to determine the actual flow needed). For the monthly time step used in modeling, a corresponding monthly volume of 1.5 million acre-feet has been used as a surrogate.
- For new diversion points at and downstream of Chico Landing, no flow event target is proposed.

#### **Aqueduct Storage**

- New storage is assumed to be connected to the California Aqueduct with 3,500 cfs diversion and discharge capacity.

### **In-stream Flow Targets**

- ERP in-stream flow targets are to be met through purchase of existing water and use of new storage allocated to environmental water supplies.

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in Alternative 1 configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.

# ALTERNATIVE 1A

Re-Operation





# ALTERNATIVE 1B

- CVP-SWP IMPROVEMENTS  
 - NEW FISH SCREEN FACILITIES  
 - INTERTIE BETWEEN CCFB-TRACY



- 
- Channel Enlargement**
- New Intake Structure**
- CVP-SWP Improvements:**  
New Fish Screen Facilities and  
Intertie between CCFB-Tracy
- LEGEND**
- Sacramento, San Joaquin and Mokelumne Rivers
  - Delta Waterways
- SACRAMENTO - SAN JOAQUIN DELTA**
- 2 0 2 4 6  
SCALE IN MILES
- 38

## ALTERNATIVE 2 - MODIFIED THROUGH DELTA CONVEYANCE

This alternative combines the programs with significant modifications of through Delta channels to improve water conveyance across the Delta. This alternative preserves the Delta common pool in that it provides a common source of water for all users dependent on Delta water supplies. Combinations of four potential conveyance configurations and three new storage configurations differentiate the four variations of this alternative.

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Varies from channel modifications primarily for water conveyance to extensive modifications for water conveyance and habitat restoration	Varies from no new storage to: 3.0 MAF Upstream (Sac) 500 TAF Upstream (SJ) 2.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW

### OVERVIEW

This alternative relies on the four programs of ecosystem restoration, water quality, water use efficiency, and long-term levee protection combined with a variety of configurations of storage and through-Delta conveyance modifications to improve each of the resource areas and to achieve Program goals and objectives. This alternative preserves the Delta common pool in that it provides a common source of fresh water for all users.

The programs contribute in multiple complementary aspects toward achieving the CALFED mission and Program goals as partially illustrated in the following descriptions of programs in the introduction to this report:

**Ecosystem Quality** - *The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.*

**Water Quality** - *The goal for water quality in the Bay-Delta system is to provide good water quality for all beneficial uses.*

**Water Supply Reliability** - *The goal for water supply reliability is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.*

**System Vulnerability** - *The goal for addressing Bay-Delta system vulnerability is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.*

## **ALTERNATIVE DESCRIPTION -VARIATIONS WITHIN ALTERNATIVE 2**

As with all Alternatives, the four programs form the foundation for Alternative 2. Watershed management and water transfer elements are the same for each alternative and are not discussed further in this section. Combinations of four potential conveyance configurations and three new storage configurations differentiate the four variations of this alternative. All Alternative 2 variations would result in permitted Delta pumping limits to be removed to allow utilization of the projects full physical pumping capacity.

### **Alternative 2A**

Alternative 2A combines and integrates the four programs with North and South Delta channel modifications designed to improve water conveyance. Alternative 2A is the "minimal" alternative to achieve improved through Delta conveyance. It provides for more efficient water conveyance from the Sacramento River through Snodgrass Slough, North Fork Mokelumne River, and Old River near Clifton Court Forebay. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and operable barriers or equivalent in the south Delta. The alternative does not provide additional water storage. Figure 2A shows the Alternative 2A configuration.

### **Ecosystem Restoration Program**

The Ecosystem Restoration Program (ERP) describes proposed ecosystem improvements throughout the Bay-Delta system, including:

- Habitat restoration of approximately 150,000 acres
- Changes in environmental water flows through operational adjustments
- Development of floodways and meander zones
- Fish passage improvements
- Fish screens installations
- Management of undesirable species
- Water quality improvements through implementation of the Water Quality Program

Alternative 2A would implement the entire ERP with the following modifications:

- Operational changes in environmental water flows would be achieved through purchase of water from willing sellers rather than reliance on regulatory mandates.
- Habitat restoration identified for the south Delta area would all be located west of the flow and stage control structures on Middle River, Grant Line Canal, and Old River.

- Habitat improvements along the North Fork Mokelumne River would be limited to establishing a riparian habitat corridor associated with setback levees constructed to modify channel conveyance.
- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions of the east levee along the South Fork Mokelumne River and protecting interior levee slopes.

## **Water Quality Program**

The CALFED Water Quality Program goal is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses. The water quality program includes programmatic actions to reduce water quality degradation from agricultural drainage, urban and industrial runoff, acid mine drainage, wastewater and industrial discharges, and natural sources. This Program focuses on reducing the release of pollutants into the Bay-Delta system and its tributaries. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. The Water Quality Program recognizes that additional benefits can be obtained by managing the timing release of remaining pollutant discharges and other dilution actions.

The entire Water Quality Program would be implemented for Alternative 1A with the following additions:

- Evaluate relocating water supply intakes (such as North Bay Aqueduct, Tracy, and Contra Costa Water District intakes) to avoid salts and organic carbon that reduce the ability to recycle water and that complicate disinfection and are sources of disinfection byproducts.
- Relocate Delta island drainage discharges away to channels other than those identified for conveyance modifications.

## **Water Use Efficiency Program**

The Water Use Efficiency Program is California's well accepted public policy that places a strong emphasis on efficient use of developed water supplies. The CALFED water use efficiency program differs from other components of a Bay-Delta solution in two fundamental ways: it is more concerned with policy, not technical issues, and most actions would be implemented by local agencies rather than CALFED agencies.

No changes in the Water Use Efficiency Program are needed to implement Alternative 2A.

## Levee System Integrity Program

The Levee System Integrity Program focuses on nine approaches to improve the long-term structural integrity of the levee system in the Delta and in specific locations upstream:

- **The Delta Levee Base Level Protection Plan** strives to use existing programs to increase the extent of Delta project and nonproject levees that meet minimum federal flood control performance criteria. Local reclamation districts would provide the primary source of resources for maintaining and improving the Delta levee system, with increased State and federal participation and resources.
- **The Delta Levee Special Improvement Projects** provide increased flood protection beyond the Delta Levee Base Level Protection Plan for Delta islands with many public benefits.
- **The Delta Island Subsidence Control Plan** promotes island subsidence to provide long-term reliability of Delta levees in coordination with other agencies and stakeholders.
- **The Delta Levee Emergency Management Plan** will build upon existing emergency management resources to protect critical Delta resources during an emergency.
- **The Delta Levee Seismic Risk Assessment** will identify and increase the understanding of the seismic risks to Delta resources and develop recommendation for increasing Delta levee seismic stability.

The entire Levee System Integrity Program would be implemented for Alternative 2A with the following modification:

- The program would be adjusted to accommodate new setback levees for improved water conveyance and flooding of McCormack Williamson Tract.

## Conveyance

A new **10,000 cfs Screened Intake at Hood** would divert water into the improved through Delta channels from the Sacramento River. This component would include:

- A gated intake with pumping plant to open channel
- Fish screen and bypass system
- Open channel to Snodgrass Slough with setback levee along east side of channel to McCormack Williamson Tract
- Relocation/replacement of existing improvements displaced by the new channel
- Breach McCormack Williamson Tract levee to flood island for shallow water habitat and water conveyance

**North Delta Channel modifications** would provide for widening the Mokelumne River channel to improve water conveyance and flood control in the northern Delta. These modifications include:

- Purchase of 600-foot wide alignment along Mokelumne River from I-5 to the San Joaquin River
- Replacement of existing levees on one side of the existing channel with new setback levees approximately 500 feet back from the existing channel
- Removal of existing levees where they obstruct the new channel and convert remaining portions into channel islands
- Relocation/replacement of existing improvements displaced by the widened channel

**South Delta Modifications** would provide for increasing the permitted capacity of existing export pumps up to their full physical capacity. These improvements include:

- A new Clifton Court Forebay intake structure
- Channel enlargement along a 4.9 mile reach in Old River
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River.
- Flow and stage control measures on Middle River, Grant Line Canal, and Old River or other methods to control flow, stage, and south Delta salinity

**CVP-SWP improvements** to provide additional operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility
- New fish screens at the Tracy Pumping Plant intake
- Intertie between Tracy Pumping Plant and Clifton Court Forebay to provide operational flexibility to minimize fisheries impacts

## **Storage**

New water storage is not included in Alternative 2A.

## **Operations**

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. No changes in these assumptions are proposed for implementation of Alternative 2A. However, some reoperation of system facilities will occur to accommodate changes in flow timing resulting from potential purchases of supplemental environmental flows from willing sellers.



## **Alternative 2B**

Alternative 2B combines and integrates the four programs with North and South Delta channel modifications designed for water conveyance and new surface and groundwater storage. The alternative is the same as Alternative 2A except it adds new water storage facilities. Figure 2B shows the Alternative 2B configuration.

### **Ecosystem Restoration Program**

Alternative 2B would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- Habitat restoration identified for the south Delta area would all be located west of the flow and stage control structures on Middle River, Grant Line Canal, and Old River.
- Habitat improvements along the North Fork Mokelumne River would be limited to establishing a riparian habitat corridor associated with setback levees constructed to modify channel conveyance.
- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions of the east levee along the South Fork Mokelumne River and protecting interior levee slopes.

### **Water Quality Program**

Same as Alternative 2A.

### **Water Use Efficiency Program**

Same as Alternative 2A.

### **Levee System Integrity Program**

Same as Alternative 2A.

### **Conveyance**

Same as Alternative 2A.

## Storage

New storage would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries
- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

## Operations

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. These are supplemented by the following specific operational assumptions for Alternative 2B:

### Surface and Groundwater Storage Components

- All new surface storage facilities will be operated primarily to maximize average annual deliveries to meet all beneficial uses.
- All new groundwater and conjunctive use facilities will be primarily operated to maximize average dry year delivery to all beneficial uses.
- Filling of and discharging from new storage will be made with the following priorities (*The following will be consistent with local water management practices and water rights*):
  - Tributary groundwater storage facilities have first priority for filling and last priority for discharging from storage (withdrawals from groundwater basins will only be made in dry and critical years).
  - Aqueduct groundwater storage facilities have second priority for filling and fourth priority for discharging from storage.
  - Aqueduct surface storage facilities have third priority for filling and third priority for discharging from storage.

- Tributary surface storage facilities have fourth priority for filling and second priority for discharging from storage.
- Delta storage facilities have fifth priority for filling and first priority for discharging from storage.
- All new storage is assumed to be split evenly among the “three beneficial use sectors”, such that we have one-third for environmental purposes, one-third for urban purposes, and one-third for agricultural purposes.
- For 500 TAF of groundwater storage, diversion capacity is 500 cfs. Discharge capacity is 500 cfs. Flow event targets as specified for surface storage are not applicable for diversions to groundwater storage.

#### **Tributary Storage (Sacramento River System) diversions to storage**

- All in stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off stream storage is 5,000 cfs.
- For new diversion points between Keswick and Chico Landing, no new diversions allowed in any given water year until a 60,000 cfs mean daily flow event that preserves the river’s natural fluvial geomorphology process has occurred at Chico Landing. (Future study will be conducted to determine the actual flow needed). For the monthly time step used in modeling, a corresponding monthly volume of 1.5 million acre-feet has been used as a surrogate.
- For new diversion points at and downstream of Chico Landing, no flow event target is proposed.

#### **Tributary Storage (San Joaquin River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off stream storage is 5,000 cfs.
- New storage is assumed to be diverted from existing canal diversion locations or assumed to be an increase of existing on stream storage. No flow event targets set.

#### **Aqueduct Storage**

- New storage is assumed to be connected to the California Aqueduct with 3,500 cfs diversion and discharge capacity.

### **In-stream Flow Targets**

- ERP in-stream flow targets are to be met through purchase of existing water and use of new storage allocated to environmental water supplies.

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in Alternative 1 configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.

### **Alternative 2D**

Alternative 2D combines and integrates the four programs with system modifications in the north and south Delta designed to improve water conveyance, to provide habitat restoration integrated with the conveyance improvements and new aqueduct storage south and downstream of the Delta. The alternative provides for more efficient water conveyance from the Sacramento River through Snodgrass Slough, South Fork Mokelumne River, and Old River near Clifton Court Forebay. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and an operable barrier or equivalent at the Head of Old River. Figure 2D shows the Alternative 2D configuration.

### **Ecosystem Restoration Program**

Alternative 2D would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- The modification of the Mokelumne River Floodway with setback levees, conversion of Bouldin Island to aquatic habitat, and construction of the East Delta Wetlands Habitat will create about 5,000 to 10,000 acres more habitat than identified in the ERP.
- Incorporate a portion of identified south Delta habitat with the setback levees along Old River.

### **Water Quality Program**

Same as Alternative 2A.

### **Water Use Efficiency Program**

Same as Alternative 2A.

### **Levee System Integrity Program**

Alternative 2D would implement the entire Levee System Integrity Program with these modifications:

- The program would be adjusted to accommodate new setback levees and the flooding of McCormack Williamson Tract, Bouldin Island, and tracts along the eastern side of the South Fork Mokelumne River.

### **Conveyance**

A new **10,000 cfs Screened Intake at Hood** would divert water into the through Delta channels from the Sacramento River. These modifications (which are identical with Alternative 2A) include:

- Gated intake with pumping plant to open channel
- Fish screen and bypass system
- Open channel to Snodgrass Slough with setback levee along east side of channel to McCormack Williamson Tract
- Relocation/replacement of existing improvements displaced by the new channel
- Breach McCormack Williamson Tract levee to flood island for shallow water habitat, emergent marsh, riparian forest, and water conveyance

**Mokelumne River Floodway and East Delta Wetlands Habitat** (channel modifications along the South Fork Mokelumne River) provide for improved conveyance and associated habitat. Modifications include:

- Setback levees on New Hope Tract about 2,000 feet east of existing alignment from Mokelumne River to Beaver Slough.
- Removal of segments of the eastern levee along South Fork Mokelumne River to provide new flooded habitat (such as Canal Ranch and Brack Tracts). Protect interior levee slopes.
- Setback levees on Terminous Tract about 2,000 feet east of existing alignment.

- Setback levees on Staten Island, south of Sycamore Slough, about 4,000 feet west of existing alignment.
- Remove portions of Bouldin Island levee to flood the island for conveyance and habitat. Interior levee slopes will be protected from erosion.
- Relocation/replacement of key infrastructure such as Highway 12.

**South Delta Habitat Modifications** would provide new habitat and allow increasing diversion capacity of existing export pumps up to their physical capacity. Improvements include:

- Setback levees along Old River from Rock Slough to Clifton Court Forebay to create approximately 3,000 foot-wide channel for conveyance and habitat.
- A new Clifton Court Forebay intake structure.
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River. (Downstream flow/stage control structures would not be constructed).

**CVP-SWP improvements** would provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility
- New fish screens at the Tracy Pumping Plant intake
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay

## Storage

**New storage** would provide opportunities for additional flow management and timing for urban, agricultural and environmental uses. Additional study will be required to determine the best storage size considering physical factors, hydrology and hydraulic constraints, the economic allocation of costs, and the assurances needed for successful multi-benefit operations. A range of facility sizes will be evaluated up to:

- 2.0 MAF surface storage off-aqueduct (South of Delta)

## Operations

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. These are supplemented by the following for Alternative 2D:

- All new surface storage facilities will be operated primarily to maximize average annual deliveries to meet all beneficial uses.

- All new storage is assumed to be split evenly among the "three beneficial use sectors", so that we have one-third for environmental purposes, one-third for urban purposes, and one-third for agricultural purposes.
- The new storage is assumed to be connected to the California Aqueduct with 3,500 cfs diversion and discharge capacity.
- Aqueduct surface storage facilities have third priority for filling and third priority for discharging from storage
- ERP targets are to be met through purchase of existing water and use of the new storage allocated to environmental water supplies.

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in Alternative 1 configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.

## **Alternative 2E**

Alternative 2E combines and integrates the four programs with modifications in the north and south Delta designed to improve for water conveyance, to provide significant habitat restoration and additional surface and groundwater storage. The conveyance and habitat portions of this alternative are the similar to Alternative 2D with the exception of the addition conveyance and habitat on Tyler Island and the elimination of the 10,000 cfs intake at Hood. Figure 2E shows the Alternative 2E configuration.

## **Ecosystem Restoration Program**

Alternative 2E would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- The modification of the Mokelumne River Floodway with setback levees, conversion of Bouldin Island and Tyler Island to aquatic habitat, and construction

of the East Delta Wetlands Habitat will about 10,000 to 20,000 acres more habitat than identified in the ERP.

- Incorporate a portion of identified south Delta habitat with the setback levees along Old River.

### **Water Quality Program**

Same as Alternative 2A.

### **Water Use Efficiency Program**

Same as Alternative 2A.

### **Levee System Integrity Program**

Alternative 2E would implement the entire Levee System Integrity Program with these modifications:

- The program would be adjusted to accommodate the new setback levees and the flooding of McCormack Williamson Tract, Bouldin Island, Tyler Island, and tracts along the eastern side of the South Fork Mokelumne River.

### **Conveyance**

**Tyler Island Aquatic Habitat** provides habitat and flow control into the central Delta. Modifications include:

- Setback levee, 500 feet west of Georgiana Slough, from the Sacramento River to weir intake into the central Delta.
- Construct 600-foot wide inflatable rubber dam to control weir elevation to control water flow.
- Construct channel section control in Georgiana Slough to prevent accelerated erosion of channel bottom; armoring with rip-rap or gabion baskets.
- Breach 2,000-foot section of Tyler Island levee on northeast side of island.
- Rip-rap all remaining interior levee slopes

**Mokelumne River Floodway and East Delta Wetlands Habitat** (channel modifications along the South Fork Mokelumne River) provide for conveyance and significant expansion of habitat. These modifications include:

- Breach McCormack Williamson Tract levee to flood island for shallow water habitat and water conveyance.



- Setback levees on New Hope Tract about 2,000 feet east of existing alignment from Mokelumne River to Beaver Slough.
- Removal of segments of the eastern levee along South Fork Mokelumne River to provide new flooded habitat (such as Canal Ranch and Brack Tracts). Protect interior levee slopes.
- Setback levees on Terminous Tract about 2,000 feet east of existing alignment.
- Setback levees on Staten Island, south of Sycamore Slough, about 4,000 feet west of existing alignment.
- Remove portions of Bouldin Island levee to flood the island for conveyance and habitat. Protect interior levee slopes.

**South Delta Habitat Modifications** would provide new habitat and allow increasing diversion capacity of existing export pumps up to their physical capacity. These improvements include:

- Setback levees along Old River from Rock Slough to Clifton Court Forebay to create approximately 3,000 foot-wide channel for conveyance and habitat.
- A new Clifton Court Forebay intake structure.
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River. Downstream flow/stage control structures would not be constructed.

**CVP-SWP improvements** provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility
- New fish screens at the Tracy Pumping Plant intake
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay

## **Storage**

**New storage** would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries

- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

### **Operations**

Same as Alternative 2B.

# ALTERNATIVE 2A

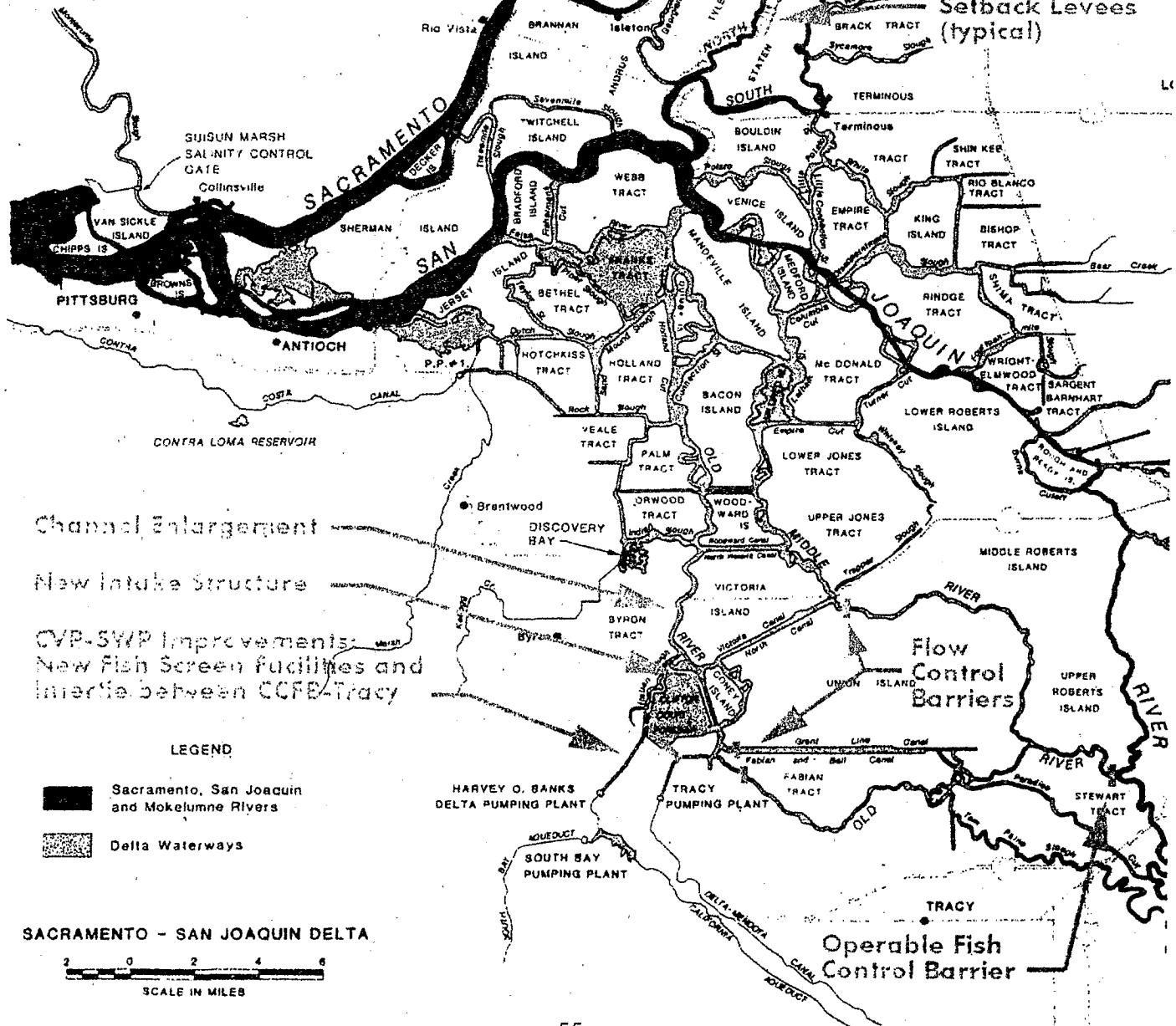
10,000 cfs Hood Intake  
North Delta Improvements  
South Delta Improvements  
CVP-SWP Improvements  
Operable Barriers or Functionally Equivalent

10,000 cfs Screened Intake

Shallow Channel Integrated with Snodgrass Slough

Flooded McCormack-Williamson Tract

Setback Levees (typical)



# ALTERNATIVE 2B

10,000 cfs Hood Intake

North Delta Improvements

South Delta Improvements

CVP-SWP Improvements

Operable Barriers or  
Functionally Equivalent

3.0 MAF Upstream Surface Storage on  
Sacramento River Tributaries

500 TAF Upstream Surface Storage on  
San Joaquin River Tributaries

2.0 MAF Off-Aqueduct Surface Storage

250 TAF Groundwater Storage  
(Sacramento Valley)

500 TAF Groundwater Storage  
(San Joaquin Valley)

10,000 cfs  
Screened Intake

Shallow Channel  
Integrated with  
Snodgrass Slough

Flooded McCormack-  
Williamson Tract

Setback Levees  
(typical)



Channel Enlargement

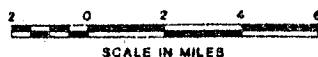
New Intake Structure

CVP-SWP Improvements:  
New Fish Screen Facilities and  
Intertie between CCFS-Tracy

## LEGEND

- Sacramento, San Joaquin and Mokelumne Rivers
- Delta Waterways

SACRAMENTO - SAN JOAQUIN DELTA



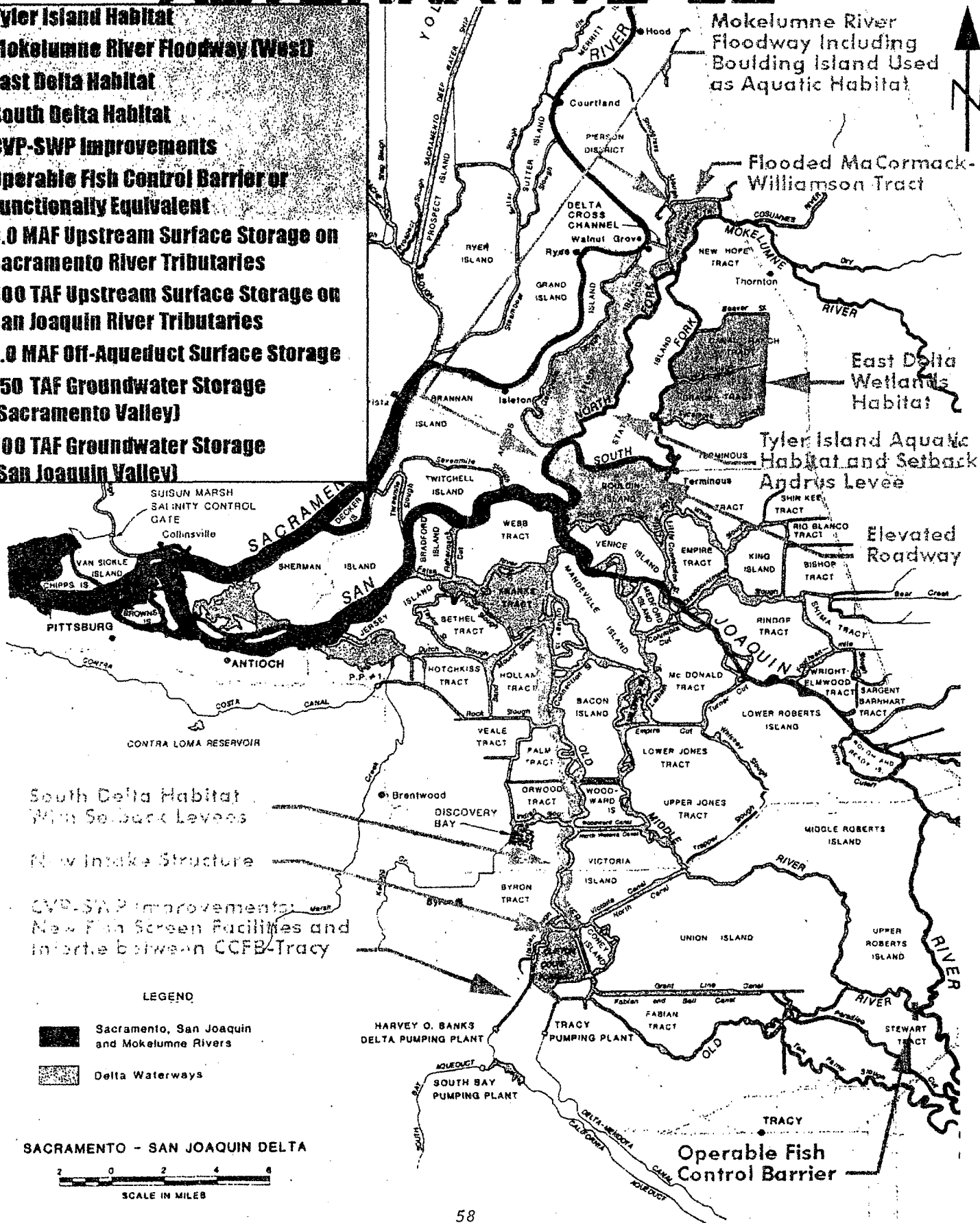
SCALE IN MILES

**10,000 cfs Hood Intake**  
**Mokelumne River Floodway (East)**  
**East Delta Habitat**  
**South Delta Habitat**  
**CVP-SWP Improvements**  
**Operable Fish Control Barrier or**  
**Functionally Equivalent**  
**2.0 MAF Off-Aqueduct**  
**Surface Storage**



# ALTERNATIVE 2E

- Tyler Island Habitat
- Mokelumne River Floodway (West)
- East Delta Habitat
- South Delta Habitat
- CVP-SWP Improvements
- Operable Fish Control Barrier or Functionally Equivalent
- 3.0 MAF Upstream Surface Storage on Sacramento River Tributaries
- 500 TAF Upstream Surface Storage on San Joaquin River Tributaries
- 2.0 MAF Off-Aqueduct Surface Storage
- 250 TAF Groundwater Storage (Sacramento Valley)
- 500 TAF Groundwater Storage (San Joaquin Valley)



## ALTERNATIVE 3 - DUAL DELTA CONVEYANCE

This alternative adds an isolated facility to the through Delta modifications of Alternative 2 which together combine with the programs to move water through and around the Delta. Combinations of five potential conveyance configurations and two new storage configurations differentiate the nine variations of this alternative

Programs				Conveyance	Water Storage
Ecosystem Restoration	Water Quality	Water Use Efficiency	Levee System Integrity	Through-Delta channel modifications vary from those primarily for water conveyance to those for water conveyance with extensive habitat restoration.  Isolated facility varies from small (5,000 cfs) to large (15,000 cfs)	Varies from no new storage to:  3.0 MAF Upstream (Sac) 500 TAF Upstream (SJ) 2.0 MAF Off-Aqueduct 250 TAF Sac. Valley GW 500 TAF San Joaquin GW

### OVERVIEW

This alternative supplements four programs of ecosystem restoration, water quality, water use efficiency, and long-term levee protection with a series of through Delta channel improvements, CVP-SWP improvements, an isolated facility, and new water storage to achieve Program goals and objectives. New surface storage upstream, in, and off-aqueduct, and south Delta and CVP-SWP improvements will provide greater flexibility in timing inflows to the Delta and withdrawals from the Delta. Upstream storage will be used for water supply, to help manage the timing of inflow to the Delta for environmental benefit, and for Delta outflow. Off-aqueduct storage, in conjunction with groundwater/conjunctive use, will be used to better manage the timing of Delta exports. Improved conveyance through the Delta and isolated conveyance around the Delta further enhance the system flexibility.

The programs contribute in multiple complementary aspects toward achieving the CALFED mission and Program goals, as partially illustrated in the following descriptions of programs in the introduction to this appendix:

**Ecosystem Quality** - *The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species.*

**Water Quality** - *The goal for water quality in the Bay-Delta system is to provide good water quality for all beneficial uses.*

**Water Supply Reliability** - *The goal for water supply reliability is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.*

**System Vulnerability** - *The goal for addressing Bay-Delta system vulnerability is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.*



## **ALTERNATIVE DESCRIPTION - VARIATIONS WITHIN ALTERNATIVE 3**

This alternative supplements four programs of ecosystem restoration, water quality, water use efficiency, and long-term levee protection with a series of through Delta channel improvements, CVP-SWP improvements, an isolated facility, and new water storage to achieve Program goals and objectives. Watershed management and water transfer elements are the same for each alternative and are not discussed further in this section. Five variations are considered for analysis. The modified conveyance would provide increased diversion capacity of existing export pumps up to their physical capacity for each variation of Alternative 3.

### **Alternative 3A**

Alternative 3A combines and integrates the four programs with North and South Delta channel modifications designed to improve water conveyance and a small ( 5,000 cfs) open channel isolated facility. This alternative is considered the "minimal" option for the dual Delta conveyance Alternative. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and operable barriers or equivalent in the south Delta. The alternative provides no new water storage. Figure 3A shows the Alternative 3A configuration.

### **Ecosystem Restoration Program**

The Ecosystem Restoration Program (ERP) describes proposed ecosystem improvements throughout the Bay-Delta system, including:

- Habitat restoration of approximately 150,000 acres
- Changes in environmental water flows through operational adjustments
- Development of floodways and meander zones
- Fish passage improvements
- Fish screens installations
- Management of undesirable species
- Water quality improvements through implementation of the Water Quality Program

Alternative 3A would implement the entire ERP with the following modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers.
- Habitat improvements along the North Fork Mokelumne River would be limited to establishing a riparian tree corridor associated with the setback levees for modified channel conveyance.

- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions the east levee along the South Fork Mokelumne River and protecting interior levee slopes.

### **Water Quality Program**

The CALFED Water Quality Program goal is to provide good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses. The Program includes programmatic actions to reduce water quality degradation from agricultural drainage, urban and industrial runoff, acid mine drainage, wastewater and industrial discharges, and natural sources. This Program focuses on reducing the release of pollutants into the Bay-Delta system and its tributaries. Reducing the total pollutant load entering the Delta will provide benefits for all water users. These include improved drinking water quality, reduced salt load for agricultural diversions, and improved water quality for the ecosystem, including reduced toxicity. The Water Quality Program recognizes that additional benefits can be obtained by managing the timing release of remaining pollutant discharges and other dilution actions.

The entire Water Quality Program would be implemented for Alternative 3A with the following addition:

- Evaluate relocating water supply intakes (such as North Bay Aqueduct, Tracy, and Contra Costa Water District intakes) to avoid salts and organic carbon that reduce the ability to recycle water and that complicate disinfection and are sources of disinfection byproducts.
- Relocate Delta island drainage discharges away from the channels identified for conveyance modifications.

### **Water Use Efficiency Program**

The Water Use Efficiency Program California's well accepted public policy that places a strong emphasis on efficient use of developed water supplies. The CALFED water use efficiency program differs from other components of a Bay-Delta solution in two fundamental ways: it is more concerned with policy, not technical issues, and most actions would be implemented by local agencies rather than CALFED agencies.

No changes in the Water Use Efficiency Program are needed to implement Alternative 3A.

## Levee System Integrity Program

The Levee System Integrity Program focuses on nine approaches to improve the long-term structural integrity of the levee system in the Delta and in specific locations upstream:

- **The Delta Levee Base Level Protection Plan** strives to use existing programs to increase the extent of Delta project and nonproject levees that meet minimum federal flood control performance criteria. Local reclamation districts would provide the primary source of resources for maintaining and improving the Delta levee system, with increased State and federal participation and resources.
- **The Delta Levee Special Improvement Projects** provide increased flood protection beyond the Delta Levee Base Level Protection Plan for Delta islands with many public benefits.
- **The Delta Island Subsidence Control Plan** promotes island subsidence to provide long-term reliability of Delta levees in coordination with other agencies and stakeholders.
- **The Delta Levee Emergency Management Plan** will build upon existing emergency management resources to protect critical Delta resources during an emergency.
- **The Delta Levee Seismic Risk Assessment** will identify and increase the understanding of the seismic risks to Delta resources and develop recommendation for increasing Delta levee seismic stability.

Alternative 3A would implement the entire Levee System Integrity Program with this modification:

- The program would be adjusted to accommodate the new setback levees for water conveyance along the North Fork Mokelumne River.

## Conveyance

**North Delta Channel Modifications** would provide for widening the Mokelumne River channel to improve water conveyance and flood control in the northern Delta. These modifications include:

- Purchase of 600-foot wide alignment along Mokelumne River from I-5 to the San Joaquin River.
- Replacement of existing levees on one side of the existing channel with new setback levees approximately 500 feet back from the existing channel.
- Removal of existing levees where they obstruct the new channel and convert remaining portions into channel islands.

- Relocation/replacement of existing improvements displaced by the widened channel.

**South Delta Modifications** would provide for increasing diversion capacity of existing export pumps up to their physical capacity. These improvements include:

- A new Clifton Court Forebay intake structure.
- Channel enlargement along a 4.9 mile reach in Old River.
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River.
- Flow and stage control structures on Middle River, Grant Line Canal, and Old River or other methods to control flow, stage, and south Delta salinity.

**CVP-SWP improvements** provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility (or at the head of Clifton Court Forebay)
- New fish screens at the Tracy Pumping Plant intake (or at the head of Clifton Court Forebay)
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay

The 5,000 cfs **isolated facility** would provide for improved operational flexibility for use in conjunction with through-Delta improvements. The isolated facility includes:

- New screened intake at Hood (or alternatively at Freeport)
- Pumping plant to open channel
- 2,000-foot wide alignment (which includes the channel and mitigation lands) from Hood to Clifton Court Forebay along the eastern side of the Delta
- 5,000 cfs open channel from Hood (or alternatively Freeport) to Clifton Court Forebay
- Relocation/replacement of existing improvements displaced by the new facility

## Storage

New water storage is not included in this alternative.

## Operations

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. No changes in these assumptions are needed for Alternative 3A except as shown below. Some reoperation of system facilities will occur to

accommodate the change in flow timing from the purchase of environmental flows from willing sellers.

### **Delta Standards with Isolated Conveyance**

- Delta Cross Channel closed September through June, open July through August.
- Isolated facilities should be operated to maximize isolated conveyance year round, consistent with the need to meet south Delta water quality objectives. The minimum levels of monthly export flows taken through the south Delta export facilities are suggested as follows:

October-March	1,000 cfs
April-June	0 cfs
July-September	1,000 cfs

- Isolated Facilities will be studied using two separate levels of ecosystem protection:
  - Existing E/I ratio
  - Isolated flow is assumed to be not included in both export and inflow in E/I ratio

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in the alternative configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.

### **Alternative 3B**

Alternative 3B combines and integrates the four programs with North and South Delta channel modifications designed for water conveyance, a small (5,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage. The alternative is the same as Alternative 3A except for the new water storage. Figure 3B shows the Alternative 3B configuration.

## **Ecosystem Restoration Program**

Alternative 3B would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- Habitat improvements along the North Fork Mokelumne River would be limited to establishing a riparian tree corridor associated with the setback levees for modified channel conveyance.
- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions the east levee along the South Fork Mokelumne River and protecting interior levee slopes.

## **Water Quality Program**

Same as Alternative 3A.

## **Water Use Efficiency Program**

Same as Alternative 3A.

## **Levee System Integrity Program**

Same as Alternative 3A.

## **Conveyance**

Conveyance modifications are the same as those included with Alternative 3A except that spur conveyance links to the Bay Area and areas east of the Delta will be studied.

## **Storage**

**New storage** would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries
- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 200 TAF in-Delta storage
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

## Operations

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. These are supplemented by the following for Alternative 3B:

### Surface and Groundwater Storage Components

- All new surface storage facilities will be operated primarily to maximize average annual deliveries to meet all beneficial uses.
- All new groundwater and conjunctive use facilities will be primarily operated to maximize average dry year deliveries to meet all beneficial uses.
- Filling of and discharging from new storage will be made with the following priorities (*The following will be modified as necessary for consistency with local water management practices and water rights*):
  - Tributary groundwater storage facilities have first priority for filling and last priority for discharging from storage (withdrawals from groundwater basins will only be made in dry and critical years).
  - Aqueduct groundwater storage facilities have second priority for filling and fourth priority for discharging from storage.
  - Aqueduct surface storage facilities have third priority for filling and third priority for discharging from storage.
  - Tributary surface storage facilities have fourth priority for filling and second priority for discharging from storage.
  - Delta storage facilities have fifth priority for filling and first priority for discharging from storage.
- The total volume of all new storage is assumed to be split evenly among the "three beneficial use sectors", such that we have one-third for environmental purposes, one-third for urban purposes, and one-third for agricultural purposes.

- For 500 TAF of groundwater storage, diversion capacity is 500 cfs. Discharge capacity is 500 cfs. Flow event targets as specified for surface storage are not applicable for diversions to groundwater storage.

#### **Tributary Storage (Sacramento River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off-stream storage is 5,000 cfs.
- For new diversion points between Keswick and Chico Landing, no new diversions are allowed in any given water year until a 60,000 cfs mean daily flow event that preserves the river's natural fluvial geomorphology process has occurred at Chico Landing. (Future study will be conducted to determine the actual flow needed). For the monthly time step used in modeling, a corresponding monthly volume of 1.5 million acre-feet has been used as a surrogate.
- For new diversion points at and downstream of Chico Landing, no flow event target is proposed.

#### **Tributary Storage (San Joaquin River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off-stream storage is 5,000 cfs.
- New storage is assumed to be diverted from existing canal diversion locations or assumed to be an increase of existing on-stream storage. No flow event targets set.

#### **Aqueduct Storage**

- New storage is assumed to be connected to the California Aqueduct with 3,500 cfs diversion and discharge capacity.

#### **In-Delta**

- Assumed diversion and discharge capacity for in-Delta storage is 5,000 cfs



### **In-stream Flow Targets**

- ERP in-stream flow targets are to be met through purchase of existing water and use of new storage allocated to environmental water supplies.

### **Delta Standards with Isolated Conveyance**

- Delta Cross Channel closed September through June, open July through August.
- Isolated facilities should be operated to maximize isolated conveyance year round, consistent with the need to meet south Delta water quality objectives. The minimum levels of monthly export flows taken through the south Delta export facilities are suggested as follows:

October-March	1,000 cfs
April-June	0 cfs
July-September	1,000 cfs

- Isolated Facilities will be studied using two separate levels of ecosystem protection:
  - Existing E/I ratio
  - Isolated flow is assumed to be not included in both export and inflow in E/I ratio

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in the alternative configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.

### **Alternative 3E**

Alternative 3E combines and integrates the four programs with North Delta channel modifications designed to improve water conveyance, a large (15,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage. The alternative is similar

to Alternative 3B except for the size of the isolated facility, and the elimination of Old River enlargement and barrier at Head of Old River. Figure 3E shows the Alternative 3E configuration.

### **Ecosystem Restoration Program**

Same as Alternative 3B.

### **Water Quality Program**

The entire Water Quality Program would be implemented for Alternative 3E with the following additions:

- Evaluate relocating water supply intakes (such as North Bay Aqueduct, Tracy, and Contra Costa Water District intakes) to avoid salts and organic carbon that reduce the ability to recycle water and that complicate disinfection and are sources of disinfection byproducts.
- Actions to deal with Delta island drainage total organic carbon control would not be needed with this alternative.

### **Water Use Efficiency Program**

Same as Alternative 3B.

### **Levee System Integrity Program**

Same as Alternative 3B.

### **Conveyance**

**North Delta Channel Modifications** would provide for widening the Mokelumne River channel to improve water conveyance and flood control in the northern Delta. These modifications include:

- Purchase of 600-foot wide alignment along Mokelumne River from I-5 to the San Joaquin River.
- Replacement of existing levees on one side of the existing channel with new setback levees approximately 500 feet back from the existing channel.
- Removal of existing levees where they obstruct the new channel and convert remaining portions into channel islands.
- Relocation/replacement of existing improvements displaced by the widened channel.

**South Delta Modifications** would provide for increasing the permitted capacity of existing export pumps up to their physical capacity. These improvements include:

- A new Clifton Court Forebay intake structure.
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River. Downstream flow/stage control structures would not be constructed.

**CVP-SWP improvements** provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility (or at the head of Clifton Court Forebay)
- New fish screens at the Tracy Pumping Plant intake (or at the head of Clifton Court Forebay)
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay

A 15,000 cfs **isolated facility** would provide for improved operational flexibility for use in conjunction with the through-Delta improvements. The isolated facility includes:

- New screened intake at Hood
- Pumping plant to open channel
- 2,000-foot wide alignment from Hood to Clifton Court Forebay along the eastern side of the Delta
- 15,000 cfs open channel from Hood to Clifton Court Forebay
- Relocation/replacement of existing improvements displaced by the new facility

### **Storage**

Same as Alternative 3B.

### **Operations**

Same as Alternative 3B.

## **Alternative 3H**

Alternative 3H combines and integrates the four programs with modified conveyance in the north and south Delta designed for water conveyance and significant habitat restoration with a small (5,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage. Figure 3H shows the Alternative 3H configuration.

## **Ecosystem Restoration Program**

Alternative 3H would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- The modification of the Mokelumne River Floodway with setback levees, conversion of Bouldin Island and Tyler Island to aquatic habitat, and construction of the East Delta Wetlands Habitat will about 10,000 to 20,000 acres more habitat than identified in the ERP.
- Incorporate a portion of identified south Delta habitat with the setback levees along Old River.

## **Water Quality Program**

Same as Alternative 3A.

## **Water Use Efficiency Program**

Same as Alternative 3A.

## **Levee System Integrity Program**

Alternative 3H would implement the entire Levee System Integrity Program with these modifications:

- The program would be adjusted to accommodate the new setback levees and the flooding of McCormack Williamson Tract, Bouldin Island, Tyler Island, and tracts along the eastern side of the South Fork Mokelumne River.

## **Conveyance**

**Tyler Island Aquatic Habitat** provides habitat and flow control into the central Delta. Modifications include:

- Setback levee, 500 feet west of Georgiana Slough, from the Sacramento River to weir intake into the central Delta.
- Construct 600-foot wide inflatable rubber dam to control weir elevation to control water flow.
- Construct channel section control in Georgiana Slough to prevent accelerated erosion of channel bottom; armoring with rip-rap or gabion baskets.

- Breach 2,000-foot section of Tyler Island levee on northeast side of island.
- Rip-rap all remaining interior levee slopes.

**Mokelumne River Floodway and East Delta Wetlands Habitat** (channel modifications along the South Fork Mokelumne River) provide for conveyance and significant expansion of habitat. These modifications include:

- Breach McCormack Williamson Tract levee to flood island for shallow water habitat and water conveyance.
- Setback levees on New Hope Tract about 2,000 feet east of existing alignment from Mokelumne River to Beaver Slough.
- Removal of segments of the eastern levee along South Fork Mokelumne River to provide new flooded habitat (such as Canal Ranch and Brack Tracts. Protect interior levee slopes.
- Setback levees on Terminous Tract about 2,000 feet east of existing alignment.
- Setback levees on Staten Island, south of Sycamore Slough, about 4,000 feet west of existing alignment.
- Remove portions of Bouldin Island levee to flood the island for conveyance and habitat. Protect interior levee slopes.

**South Delta Habitat Modifications** would provide new habitat and allow increasing diversion capacity of existing export pumps up to their physical capacity. These improvements include:

- Setback levees along Old River from Rock Slough to Clifton Court Forebay to create approximately 3,000 foot-wide channel for conveyance and habitat.
- A new Clifton Court Forebay intake structure
- Operable barrier or equivalent at the head of Old River to maintain a positive flow down the San Joaquin River. Downstream flow/stage control structures would not be constructed.

**CVP-SWP improvements** provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility (or at the head of Clifton Court Forebay)
- New fish screens at the Tracy Pumping Plant intake (or at the head of Clifton Court Forebay)
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay

The 5,000 cfs **isolated facility** would provide for improved operational flexibility for use in conjunction with through-Delta improvements. The isolated facility includes:

- New screened intake at Hood (or alternatively at Freeport)
- Pumping plant to open channel
- 2,000-foot wide alignment (which includes the channel and mitigation lands) from Hood to Clifton Court Forebay along the eastern side of the Delta
- 5,000 cfs open channel from Hood (or alternatively Freeport) to Clifton Court Forebay
- Relocation/replacement of existing improvements displaced by the new facility

### **Storage**

**New storage** would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries
- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

### **Operations**

Same as Alternative 2B.

### **Alternative 3I**

Alternative 3I combines and integrates the four programs with three new diversion locations for Tracy and Banks pumping plants and surface and groundwater storage. The new diversions could be use separately or in combination to provide increased operational flexibility. One New in-Delta water storage would receive water from one of these new diversions. The alternative also includes new fish screens at the Tracy and Banks pumping plants, and an intertie between the pumping plants. Figure 3I shows the Alternative 3I configuration.

## **Ecosystem Restoration Program**

Alternative 3I would implement the entire ERP with these modifications:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers.
- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions of the east levee along the South Fork Mokelumne River and protecting interior levee slopes.
- Habitat restoration identified for the south Delta area near the new diversion locations would be relocated to the northern and western Delta.

## **Water Quality Program**

Same as Alternative 3A.

## **Water Use Efficiency Program**

Same as Alternative 3A.

## **Levee System Integrity Program**

Alternative 3I would implement the entire Levee System Integrity Program with these modifications:

- The program would be modified to accommodate the isolated channels, and associated levees, leading from the new diversion locations to Clifton Court Forebay.
- Levees selected for breaching, and the associated flooded land, along the eastern side of the South Fork Mokelumne River would not be improved to reduce flood risk.

## **Conveyance**

Three isolated conveyance channels would convey water to Clifton Court Forebay and the Tracy Pumps from two locations on the San Joaquin River and one on Old River near Franks Tract. The New Diversion Locations would provide the flexibility to divert water from different parts of the Delta depending on need and operating criteria at the time.

**Western 15,000 cfs isolated south Delta Intake** would include:

- Intake on Holland Track near the south side of Franks Tract.
- Setback levee, approximately 500-feet from channel, along western side of Old River.
- Isolated conveyance parallel to Old River and connected to Clifton Court Forebay. The conveyance could serve water users along the alignment.
- Isolated conveyance connected to new in-Delta storage on Holland Track. The intake would be constructed to allow diversion out of the storage (may require pumps) or directly out of the Delta channel.
- Relocation/replacement of existing improvements displaced by the new facility.

**Northern 15,000 cfs Isolated South Delta Intake** would include:

- Intake from San Joaquin River at northern end of Lower Roberts Island.
- Isolated conveyance to Clifton Court Forebay. The conveyance could serve water users along the alignment.
- Relocation/replacement of existing improvements displaced by the new facility.

**Northern 15,000 cfs Isolated Sacramento River Intake** would include:

- Screened Intake from Sacramento River at Hood.
- Isolated conveyance to the Diversion on the San Joaquin River.
- Siphon under the San Joaquin River.
- Relocation/replacement of existing improvements displaced by the new facility.

**Eastern 5,000 cfs Isolated South Delta Intake** would include:

- Intake from San Joaquin River at southern end of Upper Roberts Island.
- Isolated conveyance to Clifton Court Forebay. The conveyance could serve water users along the alignment.
- Relocation/replacement of existing improvements displaced by the new facility.

**South Delta Modifications** would provide for increasing the diversion capacity of existing export pumps up to their physical capacity. These modifications include:

- A new Clifton Court Forebay intake structure.



**CVP-SWP improvements** provide for further improvements in operational flexibility. These improvements include:

- New fish screens at the Skinner Fish facility (or at the head of Clifton Court Forebay).
- New fish screens at the Tracy Pumping Plant intake (or at the head of Clifton Court Forebay).
- Interconnection between Tracy Pumping Plant and Clifton Court Forebay.

### **Storage**

New **in-Delta storage** (50,000 to 100,000 acre-feet) on Holland Tract would be connected to the Western 15,000 cfs isolated south Delta Intake.

Other **new storage** would provide opportunities for enhanced timing and flow management to more effectively and efficiently satisfy urban, agricultural and environmental beneficial users. Additional study will be required to determine optimal storage sizes considering physical factors, hydrology and hydraulic constraints, economic allocation of costs, and assurances needed for successful long-term multi-benefit operations.

A range of facility sizes will be evaluated up to:

- 3.0 MAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on Sacramento River tributaries.
- 500 TAF surface storage upstream of the Delta (enlargement of existing storage or new off-stream storage) on San Joaquin River tributaries.
- 2.0 MAF surface storage off-aqueduct (South of Delta)
- 250 TAF groundwater storage in the Sacramento Valley
- 500 TAF groundwater storage in the San Joaquin Valley

### **Operations**

The basic operating assumptions for the initial study of this alternative are described in the CALFED Benchmark Study Appendix. These are supplemented by the following for Alternative 3I:

#### **Surface and Groundwater Storage Components**

- All new surface storage facilities will be operated primarily to maximize average annual deliveries to meet all beneficial uses.
- All new groundwater and conjunctive use facilities will be primarily operated to maximize average dry year deliveries to meet all beneficial uses.

- Filling of and discharging from new storage will be made with the following priorities (*The following will be modified as necessary for consistency with local water management practices and water rights*):
  - Tributary groundwater storage facilities have first priority for filling and last priority for discharging from storage (withdrawals from groundwater basins will only be made in dry and critical years).
  - Aqueduct groundwater storage facilities have second priority for filling and fourth priority for discharging from storage.
  - Aqueduct surface storage facilities have third priority for filling and third priority for discharging from storage.
  - Tributary surface storage facilities have fourth priority for filling and second priority for discharging from storage.
  - Delta storage facilities have fifth priority for filling and first priority for discharging from storage.
- The total volume of all new storage is assumed to be split evenly among the “three beneficial use sectors”, such that we have one-third for environmental purposes, one-third for urban purposes, and one-third for agricultural purposes.
- For 500 TAF of groundwater storage, diversion capacity is 500 cfs. Discharge capacity is 500 cfs. Flow event targets as specified for surface storage are not applicable for diversions to groundwater storage.

#### **Tributary Storage (Sacramento River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off-stream storage is 5,000 cfs.
- For new diversion points between Keswick and Chico Landing, no new diversions are allowed in any given water year until a 60,000 cfs mean daily flow event that preserves the river’s natural fluvial geomorphology process has occurred at Chico Landing. (Future study will be conducted to determine the actual flow needed). For the monthly time step used in modeling, a corresponding monthly volume of 1.5 million acre-feet has been used as a surrogate.
- For new diversion points at and downstream of Chico Landing, no flow event target is proposed.

#### **Tributary Storage (San Joaquin River System) diversions to storage**

- All in-stream flow requirements must be met before diversions to new storage are allowed.
- Assumed diversion and discharge capacity for off-stream storage is 5,000 cfs.

- New storage is assumed to be diverted from existing canal diversion locations or assumed to be an increase of existing on-stream storage. No flow event targets set.

#### **Aqueduct Storage**

- New storage is assumed to be connected to the California Aqueduct with 3,500 cfs diversion and discharge capacity.

#### **In-Delta**

- Assumed diversion and discharge capacity for in-Delta storage is 5,000 cfs

#### **In-stream Flow Targets**

- ERP in-stream flow targets are to be met through purchase of existing water and use of new storage allocated to environmental water supplies.

#### **Delta Standards with Isolated Conveyance**

- Delta Cross Channel closed September through June, open July through August.
- Isolated facilities should be operated to maximize isolated conveyance year round, consistent with the need to meet south Delta water quality objectives. The minimum levels of monthly export flows taken through the south Delta export facilities are suggested as follows:

October-March	1,000 cfs
April-June	0 cfs
July-September	1,000 cfs

- Isolated Facilities will be studied using two separate levels of ecosystem protection:
  - Existing E/I ratio
  - Isolated flow is assumed to be not included in both export and inflow in E/I ratio

**Note:** These operating parameters have been developed to provide a preliminary basis for conducting system and Delta model studies of CALFED alternatives. They do not reflect the culmination of the consensus process. A wide range of operating parameters will eventually be explored as part of the alternative evaluation process.

Facilities included in the alternative configurations will be operated to provide multiple benefits for the environment, water supply reliability, and water quality improvement. Additional study will be required before CALFED can settle on the best operational mode considering the hydrology and hydraulic constraints, the size range of potential facilities, the economic allocation of costs, and the assurances needed for successful multi-benefit operations.



**Figure 6**

## 500 TAF Groundwater Storage (San Joaquin Valley)

Open Channel  
Isolated  
Facility

**CVP-SWP Improvements:** <sup>March</sup>  
New Fish Screen Facilities and  
Inter tie between CCFB-Tracy

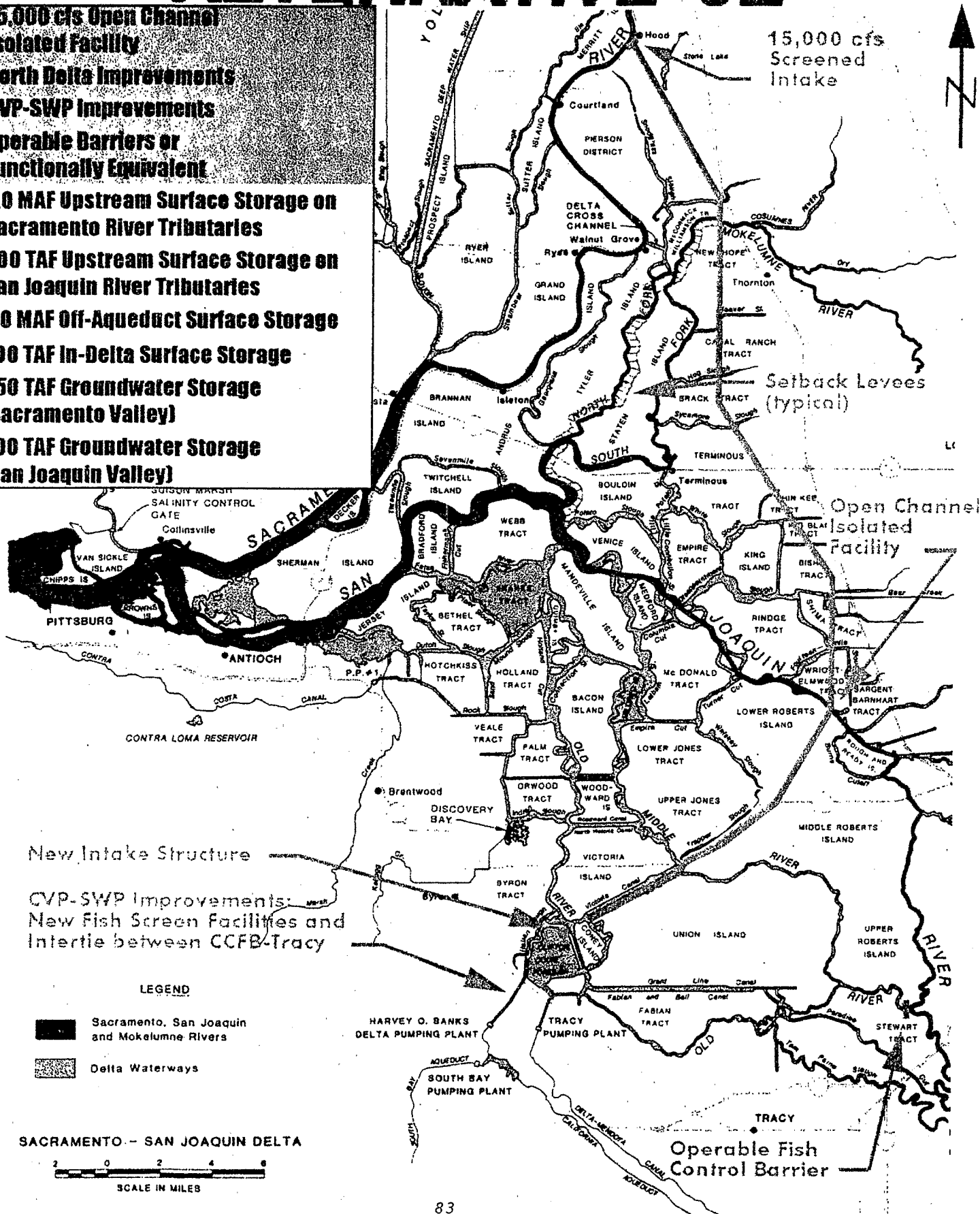
 Delta Waterways

A horizontal scale bar with markings at 2, 0, 2, 4, and 6. The text "SCALE IN MILES" is printed below the bar.

C-005958

# ALTERNATIVE 3E

- 15,000 cfs Open Channel Isolated Facility
- North Delta Improvements
- CVP-SWP Improvements
- Operable Barriers or Functionally Equivalent
- 3.0 MAF Upstream Surface Storage on Sacramento River Tributaries
- 500 TAF Upstream Surface Storage on San Joaquin River Tributaries
- 2.0 MAF Off-Aqueduct Surface Storage
- 200 TAF In-Delta Surface Storage
- 250 TAF Groundwater Storage (Sacramento Valley)
- 500 TAF Groundwater Storage (San Joaquin Valley)



# ALTERNATIVE 3H

- 5,000 cfs Open Channel Isolated Facility
- Tyler Island Habitat
- Mokelumne River Floodway (West)
- East Delta Habitat
- South Delta Habitat
- CVP-SWP Improvements
- Operable Fish Control Barrier or Functionally Equivalent
- 3.0 MAF Upstream Surface Storage on Sacramento River Tributaries
- 500 TAF Upstream Surface Storage on San Joaquin River Tributaries
- 2.0 MAF Off-Aqueduct Surface Storage
- 250 TAF Groundwater Storage (Sacramento Valley)
- 500 TAF Groundwater Storage (San Joaquin Valley)





# ALTERNATIVE 3I

Western 15,000 cfs Isolated  
South Delta Intake

Northern 15,000 cfs Isolated  
South Delta Intake

Eastern 5,000 cfs Isolated  
South Delta Intake

CVP-SWP Improvements

3.0 MAF Upstream Surface Storage on  
Sacramento River Tributaries

500 TAF Upstream Surface Storage on  
San Joaquin River Tributaries

2.0 MAF Off-Aqueduct Surface Storage

250 TAF Groundwater Storage  
(Sacramento Valley)

500 TAF Groundwater Storage  
(San Joaquin Valley)

